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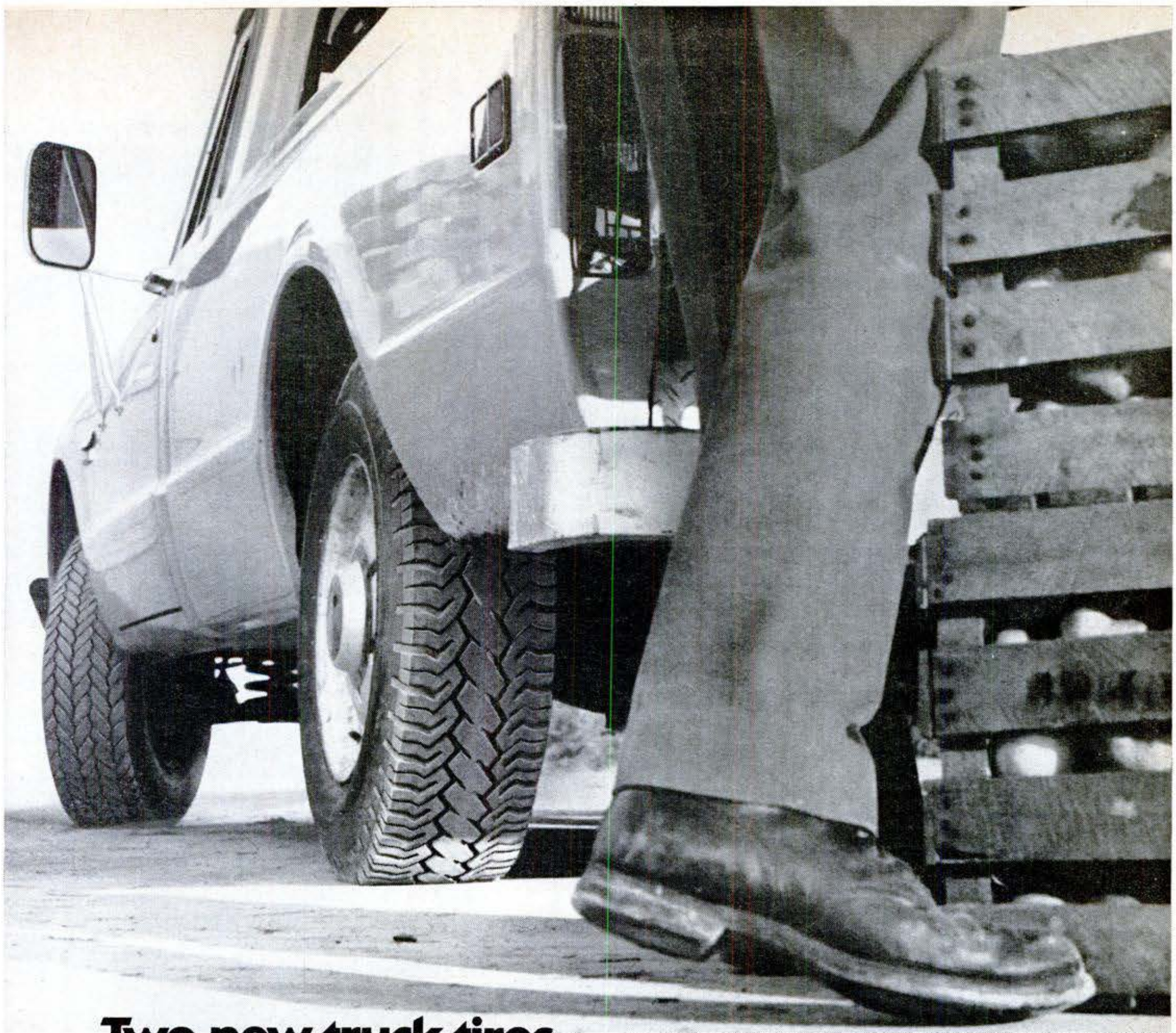

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MARCH 1971 Founded in 1872/Vol. 198, No. 3

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COVER PHOTO BY OZZIE SWEET

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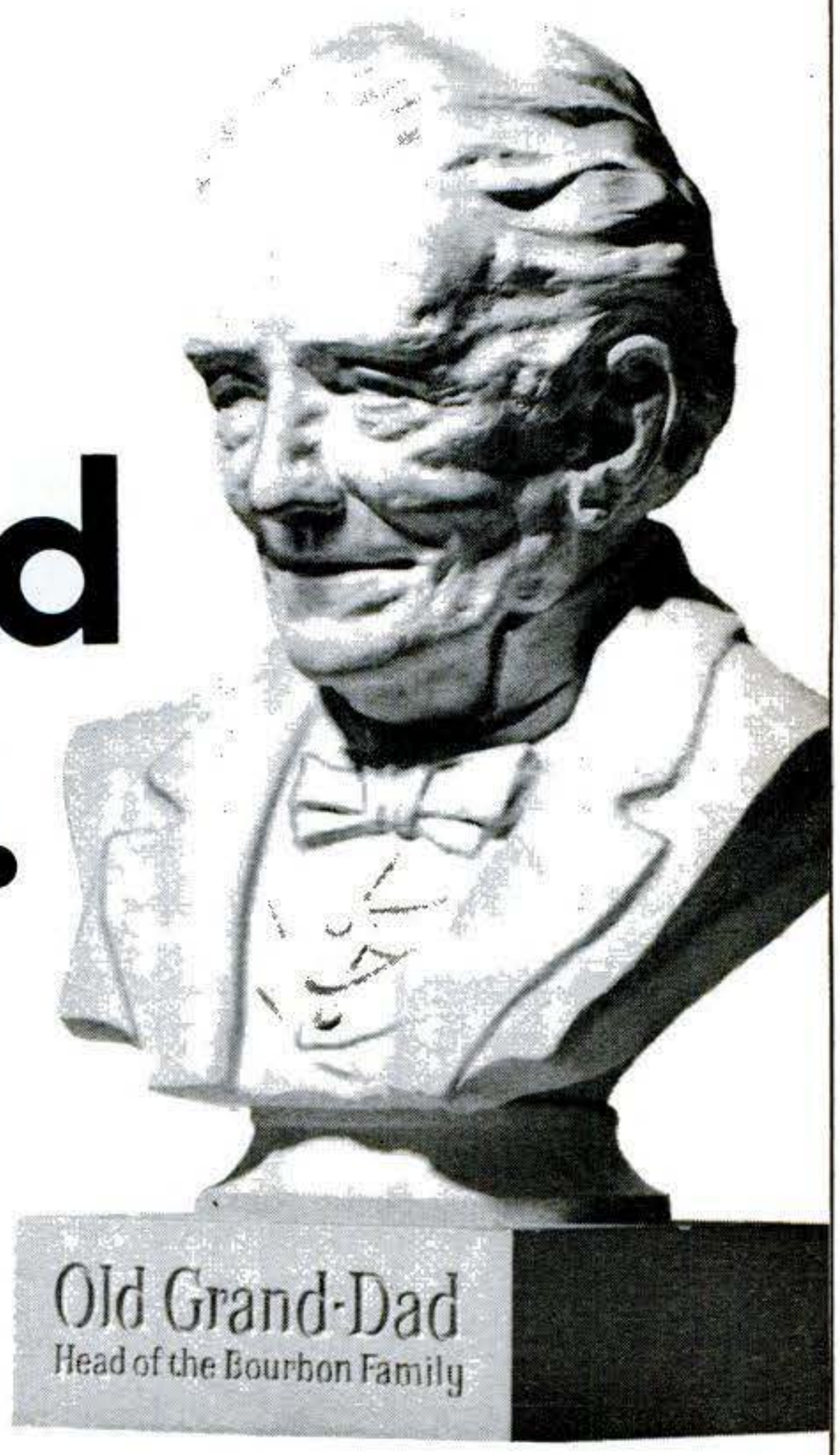

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PS Readers Talk Back

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Likes to make up his own mind

After reading "The Case For/Against No-Fault Auto Insurance" [Jan.], I see why PS remains the best men's magazine ever. One sentence tells it all:

"Read their provocative arguments and decide the issue for yourself."

This is democracy. It's this that makes the difference between propaganda and democracy.

PAUL DICK, Cincinnati, Ohio

. . . Both Senator Hart and Paul Wise have good points for their sides. However, no-fault insurance without the extraneous strings the senator would put on it, is a step in the right direction.

J. F. GREIFF, New Carlisle, Ind.

. . . I do not want federal control of anything, especially insurance. Insurance companies need not, and should not, insure the bad drivers. Just make it so costly that they cannot drive.

HAROLD A. LEACH, N. Webster, Ind.

Project filled the bill

For a long time I've been looking for an inexpensive and curious electronic project, so I'm glad writers Bawer and Hawkins made up the "Electronic Tic-Tac-Toe in a Cigarette Box" [Dec.].

The box was a little small for me though, so I modified it to let the switches and bulbs occupy their own compartment. This system worked very well and afforded maximum accessibility. I hope that your electronic whizzes keep dreaming up more of these brain-children.

SETH HEFTER, Wilkes-Barre, Pa.

Pinto versus Vega

Reading "The Pinto and the Vega: 10,000 Miles Later" [Jan.], it struck me that Detroit is vainly attempting to give the public something close to what foreign manufacturers are already giving us—quality. The new small cars are an improvement over the regular dumb, oversized domestic marshmallows. But they're still an apparent stopgap measure to halt the influx of dreaded foreign imports. Watch and see if the powers-that-be in Detroit don't make the majority of this new breed "bigger and better" in the coming years. It's happened before, and it'll happen again.

ARDEN B. PETERS, Woodburn, Ore.

. . . If Detroit is seeking to make a comeback with a smaller car, why not rebuild some of the old successful models? I'm sure if the 1940 Ford and the 1957 Chevy two-doors were put on showroom floors today, you would have to put guards at dealers' doors to limit customer inflow. With the small engines and cubic intake, plus the added PCV on them, you'd reduce pollution, too.

C. L. YOUNT, Jeffersonville, Ind.

. . . One of the biggest complaints about the Vega seems to be the not-tight-enough cap on the gas filler. GM knows of this problem and has sent replacement caps to all owners of '71 GM autos. The new cap is so designed that it requires a two-step procedure, and is a little more trouble. But it ought to prove much safer than the conventional type because it has a safety pressure release that will allow any pressure in the tank to escape safely.

ROBERT G. HOGG, Oil City, Pa.

Man-powered flight

Paul Wahl's "Man-Powered Flight" [Jan.] was very interesting because the power-to-weight ratio of the human body is very poor (as you pointed out). But I noticed one thing—all the planes you showed have the propeller mounted at the very rear of the plane. Why? I think that a pusher-type propeller would be very ineffective when powered by such a weak source as man.

SWINDT BUTTERFIELD II, Dayton, Ohio

Paul Wahl says most designers regard the pusher system as more efficient than the tractor because locating the airscrew behind the wing, as a pusher propeller, places it where it will not disturb the free airflow over the wing.

Score one for our side

R. J. DeCristoforo has scored again with "Big Band-Saw Table: Jack-of-Many-Jobs" [Jan.]—another practical and helpful article for the wood craftsman.

HOWARD R. SCHRAMM, Maple Heights, Ohio

Needling the needler

The reader who complained about the hint on using a hypodermic needle to fix a vinyl cartop [PS Readers Talk Back, Jan.] concluded that states allowing the sale of the needle better shape up. I think the people using the needle should shape up, or we'll need a prescription to buy a car. A hypodermic needle is a useful tool used by skilled craftsmen for

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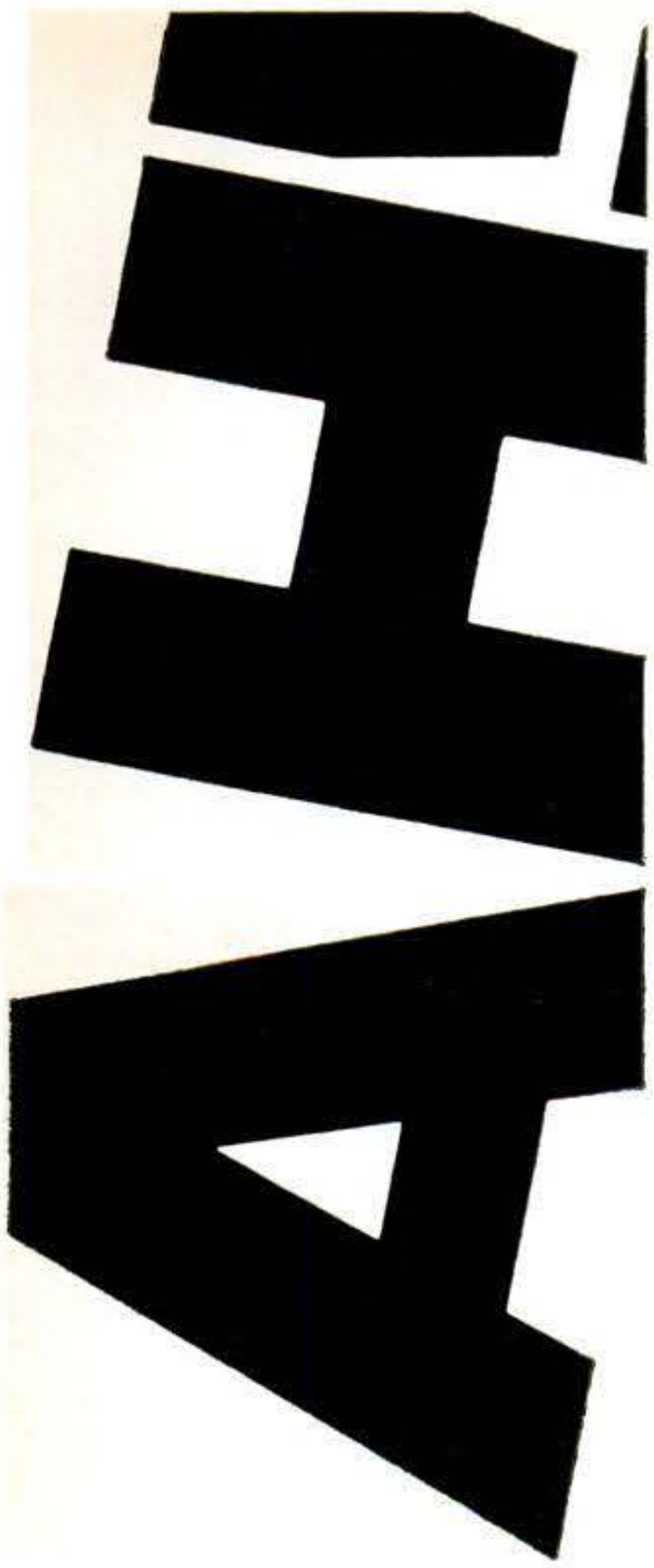

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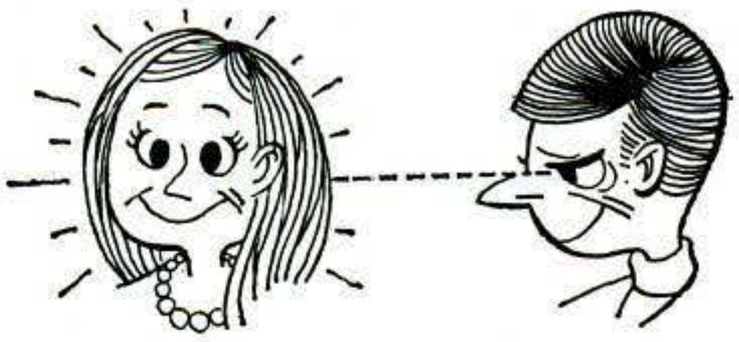
gluing in hard places to get at. And now this reader is relating this useful tool to crime. Let's fight the criminal, not the objects he uses to commit his crimes.

ROBERT J. DUNN JR., Springfield, Mass.

Harnessing brain power



"They've Found a Wish Switch in Your Brain" [Jan.] was very interesting. The average person is unaware of the stupendous power of his mind, once it is properly harnessed and directed. The time will come when many of the things we now do with the aid of machines will be done directly and more efficiently by the mind.

JAMES VICK,
Petersburg, Va.

Airborne sardines

Ben Kocivar says that tri-jets ["Giant Tri-Jets are Coming," Dec.] will have eight or nine seats across in the tourist cabin, "as the 747 does."

He evidently did not see the 747 my wife and I took to Europe last summer. It had 10 seats across in the tourist section. The seating engineers must have had some experience as sardine packers before they took on this seating job.

E. E. FORRER, Springfield, Ohio

New use for Corvairs

I thought PS readers might be interested in my flying Corvair. The plywood

platform on the hood is only attached while the engine is hand-cranked. It has no self-starter. The idea: The auto/plane will enable me to travel if flying weather is unfavorable. I hope to flight-test it this spring.

ERWIN E. STOCKWELL, Orange, Mass.

Improves a lifesaver

I believe your lifesaver for rechargeables ["All Those Little Batteries," Jan.] could be made more versatile by replacing the resistors with a rheostat whose dial has been marked with different resistance values. Construction of this tester would also be neater and easier with the use of battery clips or holders instead of the alligator-clip arrangement shown.

JOHN ANDERSON, Charleston, W. Va.

Cold truth on new air conditioner

Contrary to implications by the author of "Sensational New Auto Air Conditioners" [Dec.], hot air cannot be extracted before it enters the heat exchanger for the purpose of hot-air windshield defrosting. That's because the air pressure must first be reduced, thereby cooling the air to near the ambient temperature at intake (energy added by the system would result in only slightly higher discharge temperature).

To control cooled-air discharge temperature inside the car without reducing the circulation, as the tempering vane would do, may I suggest adding a simple bypass device that could divert a variable amount of air around the heat exchanger? Upon remixing with the high-pressure air, or direct venting into the cold-air discharge, the unremoved heat from the bypassed air would moderate the cold-air discharge temperature to a more desirable level. Coupled to an automatic device sensitive to engine rpm changes, it could provide a more uniform temperature over a greater range of engine speed. And with the hot-air tempering vane incorporated into this system, more-uniform air discharge rates could similarly be accomplished over a range of engine rpm.

ROBERT H. LEILICH
Mt. Prospect, Ill.

Wants light switch in ignition

Is there any reason why the headlight switch cannot be run through the ignition accessory switch? It might save a lot of run-down batteries when lights are used during daylight hours.

ALDEN C. PALMER JR., Indianapolis, Ind.

A lot of people don't want their headlights on as soon as they start the engine, or all the time it's running.

Emission control—a team effort?

I've always understood that in order to achieve optimum NO_x control, a catalytic converter alone could not do the job. I thought that exhaust-gas recirculation was necessary. Why doesn't UOP make use of an exhaust-gas recirculator? With their splendid catalyst [Dec.] with 90 percent reduction of harmful emissions, the addition of a recirculator such as Ford's EGR Intercooler would achieve even better results.

KENNETH KNAPP, Glen Ridge, N.J.

That interesting guy—Gus

I am not against allowing Mr. Bunn to retire, but what about reprinting some of the old Gus Wilson stories? I go through my old issues of PS every now and then, and always find Gus interesting and informative, even the second and third time around.

THEODORE BUNNELL, Bethany, W. Va.

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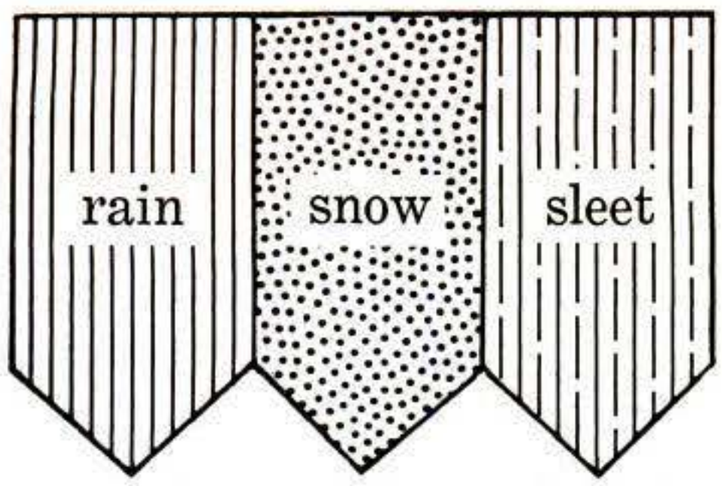


Pick a real beast of a day. When it's snowy outside, or rainy, or icy.

Take your own car, and taking your own sweet time, drive cautiously to your nearest Renault dealer.

Then slide behind the wheel of a Renault 16 and see how little sliding you do after that.

Hit the brakes on a rain-swept street and the front-wheel disc brakes stop you as straight and true as an arrow.

Go into a turn and the front-wheel drive anchored down by the weight of the front engine pulls you through lovingly. Predictably.

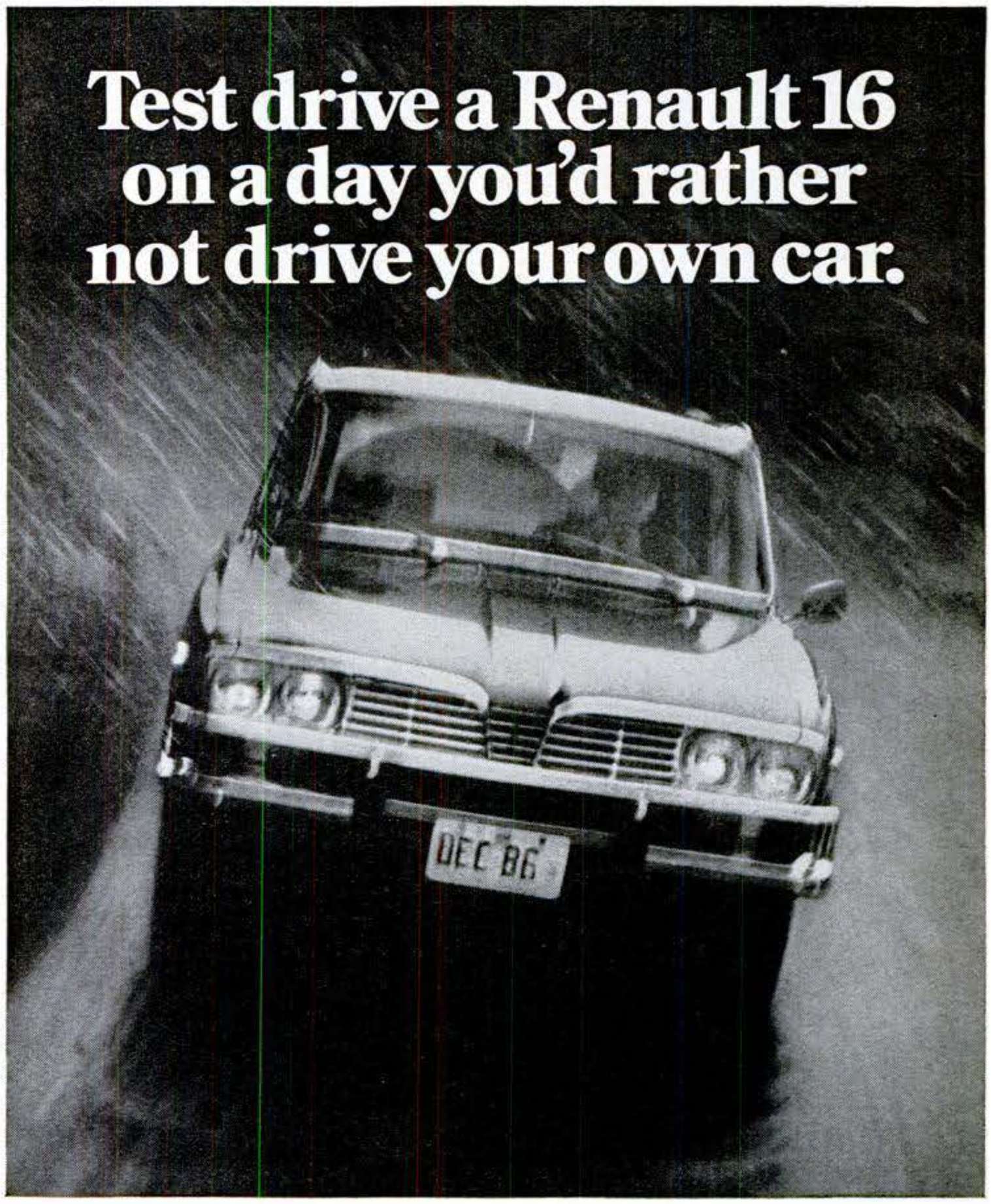
While you're in that turn, savour the sweet, tight precision of rack-and-pinion steering. What you don't need on mushy roads is mushy steering.

And don't bother swerving to avoid any bumps. Because all four wheels are independently suspended. So only the wheels get bumped, not the entire car.

When you feel all these things, plus a few we haven't even mentioned, working together, you'll know you're in a machine that marries you fiercely to the road. Even on surfaces that turn other cars into giant skates.

Remember our invitation the next time the weatherman says it's going to be good and rotten outside.

In fact, since the Renault 16 handles the way it handles, the rottener the day, the better we like it.



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Everything you've heard about camper-pickup engines is probably wrong.

The Number One Source for pickup engine information is usually the guy in the next pickup.

Unfortunately, he's also one of the least informed sources.

He's had to get his information just as you've had to. By asking someone else. And because most pickup owners operate under a variety of popular misconceptions, what he knows for sure isn't always so.

Putting a car V-8 in a pickup doesn't make it a truck V-8.

Most pickups are powered by car engines. Not truck engines. And there's a very good reason why.

Pickup manufacturers, in order to keep costs down, use the parts they have on hand. In effect, they "rob" their other assembly lines. If their other assembly lines have cars on them, they use as many car parts as possible. That includes engines.

Our other assembly lines have trucks on them.

So many of the engines in our pickups are the same ones we bolt into our big, gas-engined highway rigs. They're engines specially designed for a long lifetime of heavy hauling.

A truck engine accomplishes more without working as hard.

Because truck engines are built to serve the needs of profit-minded businessmen, they have to meet certain criteria.

They have to last a long time. Ours do. They're made a little beefier than most engines, to withstand rugged use. And, as the chart shows, they develop their power peaks at lower rpm's than most engines. So they don't have to turn as fast—and wear as fast—as most other engines.

They have to be honest, and deliver the horsepower we promise. That's on the chart, too.

All engines have "two" horsepower ratings.

The one listed as "gross rated horsepower" is what the engine develops on the test stand. It's usually the horsepower used in advertising.

The "net horsepower" is what you wind up with, once the engine's in the pickup. It's a lower rating because of a horsepower loss in the accessories. You can't avoid losing some of it. All you can do is make sure you don't lose much.

We've taken precautions in that direction. International engines are designed to lose as little horsepower as possible.

What starts out to be a more powerful engine (205 HP. vs. our 193) ends up being less powerful (150 net HP. vs. our 173). That's important to know when you're selecting an engine to fit your requirements exactly.

Just putting a truck engine in a pickup doesn't make it a truck.

There's more to building a rugged, reliable pickup than just engines. There are transmissions. Brakes. Suspensions. Exteriors. And interiors.

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Manufacturer	Engine	Rated HP.	Net HP.
International	V-304 V-345 V-392	193.1 @ 4400 rpm 196.7 @ 4000 rpm 253.0 @ 4200 rpm	173.0 @ 3900 rpm 182.3 @ 3800 rpm 235.9 @ 3600 rpm
Manufacturer "A"	302 V8 360 V8 390 V8	205.0 @ 4600 rpm 215.0 @ 4400 rpm 255.0 @ 4400 rpm	150.0 @ 4000 rpm 177.0 @ 4100 rpm 180.0 @ 4000 rpm
Manufacturer "B"	307 V8 350 V8 402 V8	200.0 @ 4600 rpm 250.0 @ 4600 rpm 300.0 @ 4800 rpm	135.0 @ 4000 rpm 170.0 @ 4000 rpm 240.0 @ 4400 rpm

Like everyone else, we're taking from other assembly lines to give you these things.

But we're giving you something different.

Our 1210 Camper Special pickup has a leaf spring suspension at all four corners. It's standard equipment. How good is it? Think of it this way: a coil spring gives you one point of suspension per wheel. A leaf spring gives you two. As standard equipment, one popular competitive model has coil springs all around...a total of 4 points of suspension. Another, as standard equipment, has coils in the front, leafs in the rear...a total of 6 points of suspension. As standard equipment, an INTERNATIONAL® 1210 Camper Special has leaf springs all around. A total of 8 points of suspension. How many points of suspension do you want...4, 6 or 8?

International transmissions are built for trucks. So they're up to handling the big jobs. You can choose from two 3-speeds, two 4-speeds, a 5-speed heavy-duty, a 5-speed with overdrive, and a rugged 3-speed automatic.

Engines and transmissions are only the start of an option list that includes 4-wheel drive, extra-duty electrical and cooling systems, a binful of rear-end ratios...and all the amenities like air conditioning, AM-FM radios, power steering and brakes, and more.

What's most important about all of them is that they go together to build a truck. Not just a pickup.

The International 1210 Camper Special pickup.

See it, test drive it at your International Truck dealer.

INTERNATIONAL® TRUCKS

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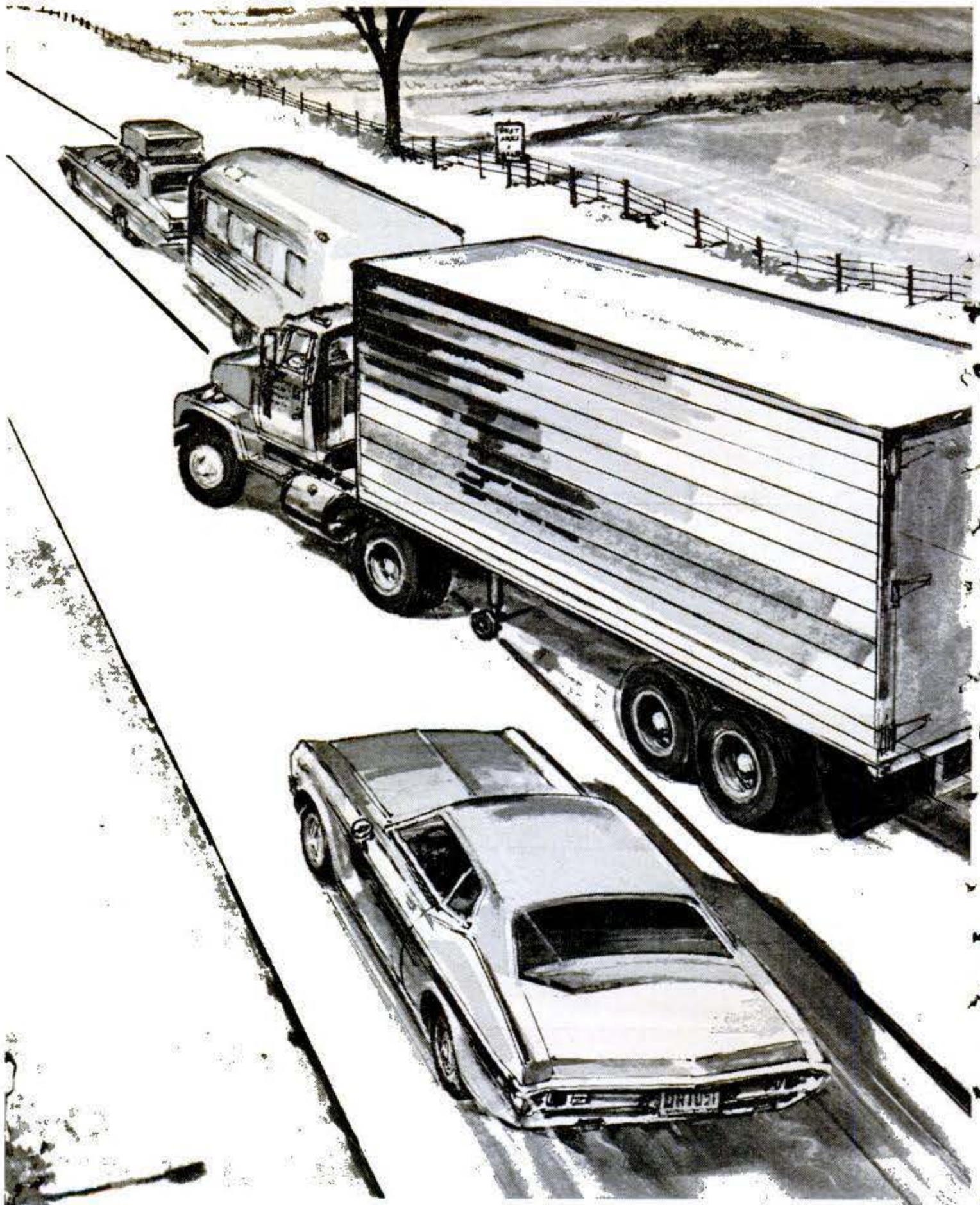

THE SKILLFUL DRIVER

If a Truck Pulls Out Suddenly...

You're driving in the fast lane of a modern highway, in perfect weather conditions, right up at the speed limit, passing a lot of slower traffic. You're about to overtake a big truck-and-semitrailer combination, when the driver pulls over in your lane, misjudging your speed and distance. You have about one second to cut 25-30 mph off your speed, or you'll hit the truck. Brake hard. Good brakes can do the job. If they fade, veer left, and use as much of the shoulder as you have to. Never try to speed up and get around the truck, even if there's a wide, solid shoulder. You never know what you'll be jumping into if you do get ahead of the truck. You might then *cause* an accident; by driving defensively, you *avert* a potential multi-vehicle crash.

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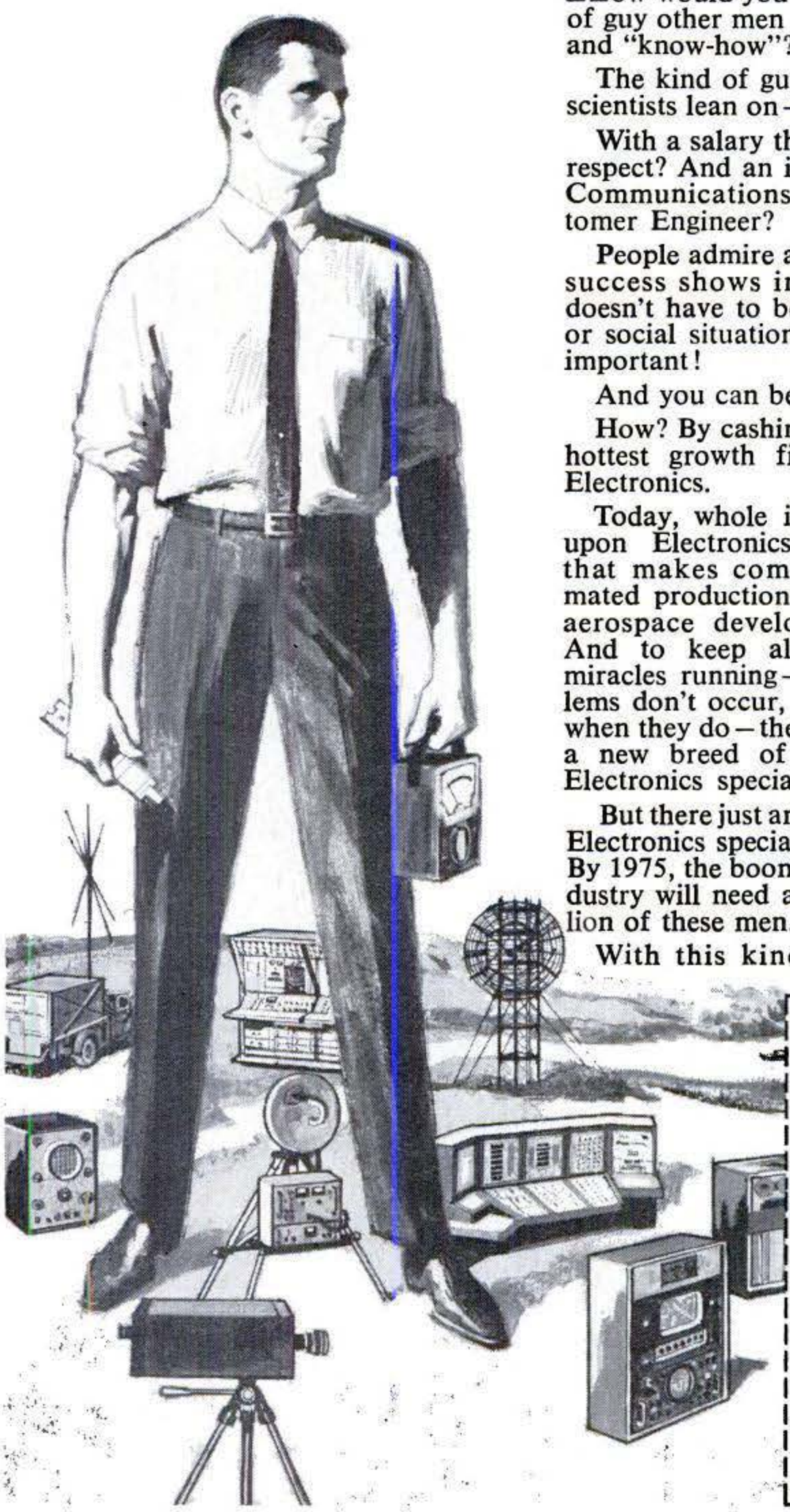
You're a pretty important guy

...when you know Electronics. And now you can learn enough to break into this exciting field right at home in your spare time.



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The kind of guy businessmen and scientists lean on—and listen to?

With a salary that can bring a guy respect? And an impressive title like Communications Officer, or Customer Engineer?

People admire a man like that. His success shows in his bearing. He doesn't have to be timid in business or social situations any more...he's important!

And you can be that man!

How? By cashing in on one of the hottest growth fields of all time: Electronics.

Today, whole industries are built upon Electronics. It's Electronics that makes computers and automated production lines and modern aerospace developments possible. And to keep all these electronic miracles running—to see that problems don't occur, and to solve them when they do—the world depends on a new breed of professional: the Electronics specialist.

But there just aren't enough trained Electronics specialists to go around! By 1975, the booming Electronics industry will need an estimated 4 million of these men.

With this kind of demand for qualified people, you can earn the kind of salary you've always dreamed about. Once you have some experience, you can make up to $5, $6, $7 an hour. $200, $225, $250 a week. $8,000, $10,000, $12,000 a year—doing work you'll really enjoy!

You might think you need college to break into this great field. But you don't. You don't even have to leave home to go to technical school.

The Cleveland Institute of Electronics can teach you all you need to know in your spare time at home.

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Thin-Film Mirror Simplifies Projection TV

By JOHN R. FREE

TV images projected on the screens are made up of reflections from a two-in.-by-two-in. mirror like that held by John A. van Raalte, who developed the metal-alloy device. Tiny dust particles on the prototype mirrors form large spots (above).

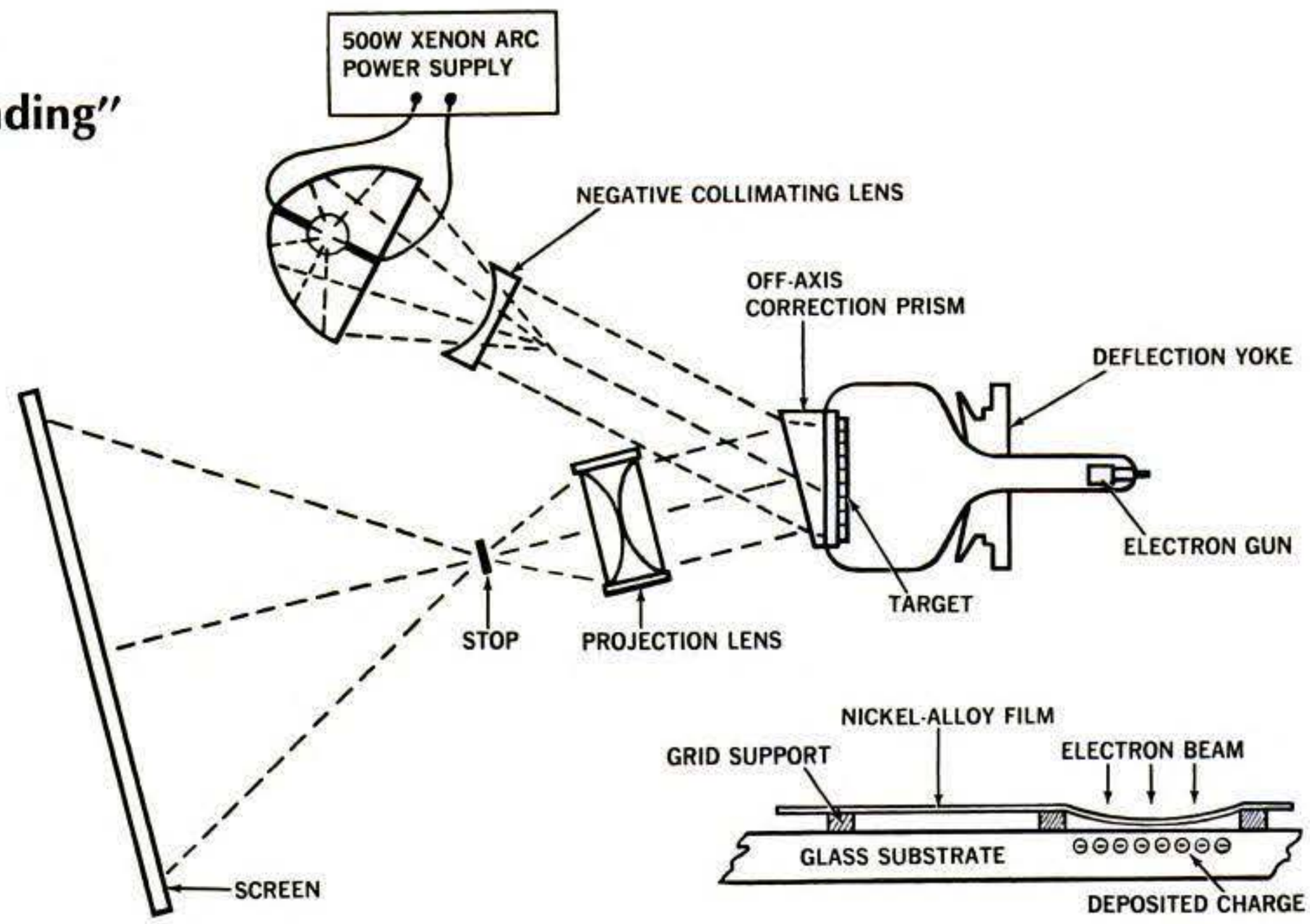
Movie-like images are beamed on a 3-by-4-foot screen by "bending" a metallic mirror at TV speeds

Like to transform one of your living-room walls into a screen for off-the-air TV? It's already possible if you're willing to spend thousands for one of the professional TV-projection systems on the market.

But now a projector for black-and-white TV under development at RCA Laboratories may pull the price down to hundreds of dollars. The heart of RCA's system is a thin-film metal mirror that can be mass-produced like electronic integrated circuits.

This target mirror is mounted inside the glass faceplate of a cathode ray tube. An electron beam sweeps back and forth over the target, forming an image like the beam in a conventional TV picture tube.

Instead of causing phosphor particles to glow, however, the beam penetrates the thin film, leaving a negative charge pattern on the target's glass substrate. For 1/30 second, the time required to form one frame of a TV picture, this charge attracts the metal film to 50- to 100-micron-wide spaces on the supporting grid. Then the charge bleeds off and the mirror flattens out until the next beam sweep.



A prism on the projector tube uniformly illuminates the mirror target with bright light. Target (lower right) varies reflected-light intensity at points bent by the beam.

(High quality projection-TV systems use complex and costly tubes with a thin oil film deformed by the beam.)

When the metal mirror is flat (no signal), all the light from a bright external source is focused onto an opaque optical stop. A TV image is formed when reflections from tiny spots deformed by the beam pass around the stop and fall on a screen. The amount of mirror deformation at each point determines the picture contrast.

Color? "All our TV research is undertaken with color in mind," RCA says. Three projector tubes—corresponding to a color set's three electron guns—could do the job. PS

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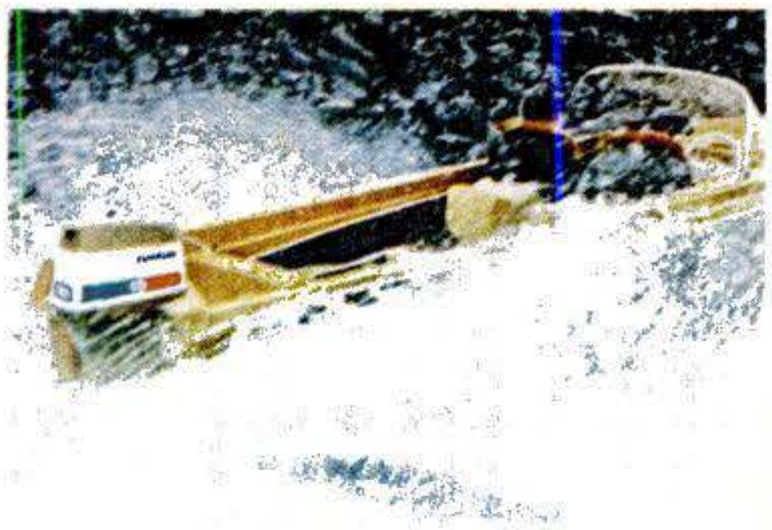

It makes more sense for more kinds of boating than any motor ever built.

Evinrude's 60 hp Triumph does *all* the things an all-purpose motor ought to do.

It delivers competition-caliber *speed*. Triumph holds the World's closed course runabout record for its class, and for the next larger class.

It's tuned and geared and propellered for *power*. Big-boat, big-load, big-water power. The kind you normally need a 65 or 75 hp motor for.

It's a skier's *ski motor*. With low-end muscle for gang skiing starts, and top-end drive that stands up to slalom cuts by tournament-class skiers.

It trolls by the hour — thanks to straight-in fueling that eliminates puddling and "loading".

With all its versatility, Triumph actually costs less to run than motors that can't match it in performance.

There are two very good reasons why: (1) Loop-charging; and (2) Pressure-pulse exhaust tuning.

Loop-charging is a more efficient way of charging an engine with fuel — that eliminates the need for deflector "humps" on the pistons and deflector bulges in the combustion chamber.

Pressure-pulse tuning converts exhaust energy into usable power — as much as 20% more power. Which helps explain why Triumph delivers so much performance on so little fuel.

It's the largest selling motor in or near its class.

It deserves to be.

Write for catalog, Evinrude Motors, 4163 N. 27th St., Milwaukee, Wis. 53216.

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BUICK MOTOR DIVISION

We give you better reasons to buy a new car than anybody else.

Pictured above are the new Buick Skylark Custom (left) and the Buick GS.

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Modest prices don't have to mean modest cars. In Skylark's case, it doesn't. Here are the reasons why. Reasons you can believe in:

Pre-tested tires.
Every tire on every 1971 Skylark and GS has been tested for uniformity under actual loaded conditions.To help give you a smoother ride.

Balanced braking.
The power braking system is equipped with a unique valve that proportions the braking force from front to rear. Which helps give you smooth, quick, straight-line stops. Comes with the available power front disc brakes.

Traditional Buick quality.
A semi-closed cooling system that should never overheat, even with air conditioning. Skylark is the only car in its price class that has it. Side guard beams for protection. A rustproofed body with acrylic paint six coats deep. And more. Ask your dealer.

The 1971 Buicks are waiting for you to test-drive now.

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Want a Big New Wagon? Look at the Intermediates!

You get a lot of wagon here. The '71 Matador, Coronet, and Montego are bigger and roomier than ever

By **JAN P. NORBYE** / *PS Automotive Editor* **and JIM DUNNE** / *PS Detroit Editor*

PHOTOS BY A. J. HAND

The term "intermediate" once meant halfway between the compacts and the full-size cars. But all that's changed now. Look at these '71 intermediates. They're just about the size you would expect in a big wagon!

In fact, they're bigger than the big wagons used to be, only 10 years ago. Now they can handle full-size jobs—like taking a whole family on a vacation trip with all their pick-and-pack, carrying small furniture and equipment when moving, doing school-bus duty, or hauling a week's food supplies for a large family.

They look almost like passenger cars, but there are many differences. Weight distribution is different, so recommended tire pressures in the rear wheels are about 50 percent higher than in front. And don't expect these wagons to handle like cars. They don't. In an emergency situation, the tail end will break away at lower speed. The wagons proved slower in handling tests than cars of similar wheelbase and weight.

We recommend a V8 engine for these wagons. You may think it extravagant for city and suburban driving, but you'll need it when you're touring the mountains with a big crowd and luggage aboard. And a big engine really doesn't burn much more gas. Tests have proved that in highway driving, vehicle weight and frontal area count for more than cubic inches of engine displacement. Once you've decided on a big (intermediate) wagon, you're not going to save much gasoline with a smaller engine.

V8-powered intermediate wagons are great highway cars. They'll cruise at any legal speed with any load up to their limit, without stress or fuss. Since the full-size wagons are also bigger than ever, the intermediates have the advantage in maneuverabil-

Matador by American Motors (top) takes the place of the Rebel. With folded back seat, maximum cargo space is 91.12 cubic feet. Dodge Coronet (center) has 91.3 cubic feet of cargo space; the Mercury Montego (bottom) is smaller, with 85.2 cubic feet. Montego wheelbase is 114 inches; in the other two wagons it's 118 inches.

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Saturday morning is the supermarket and car wash and laundry and noisy crowds and finally, it's time to relax, and...

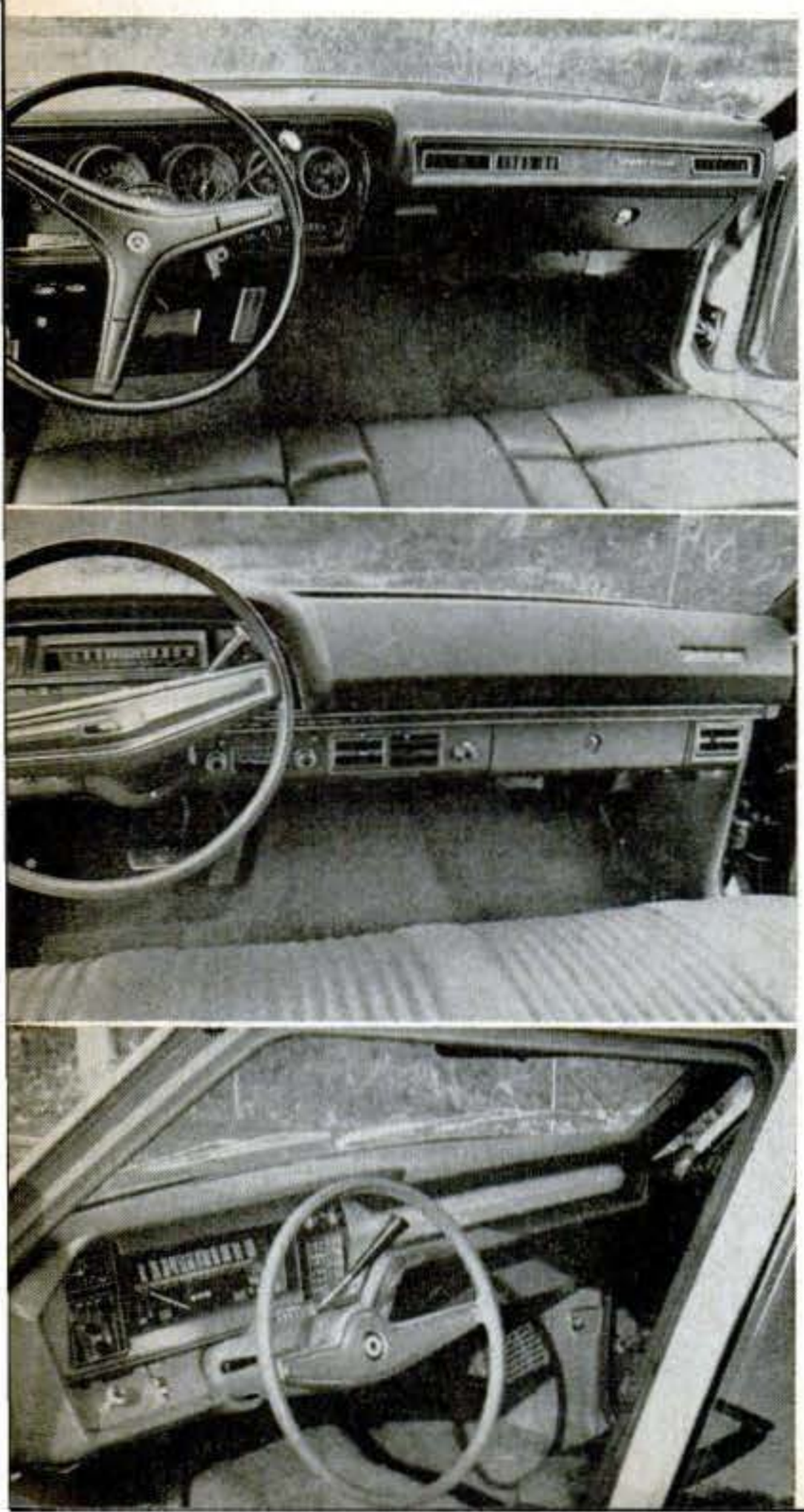
This...is the L&M moment.

A time for you to take it easy... and enjoy a whole new cigarette. New L&M. With a rich new blend and rich new flavor. Share the pleasure, share the moment... now.

NEW, RICH L&M

Floor length of Coronet (top) is 94.3 inches; width of floor between wheel housings, 48.5.; maximum cargo height, 31.6 inches. Matador (above) now has tailgate that opens and closes with glass in "up" position. Maximum cargo width is 45.08 inches.

Coronet spare wheel (top) stores behind panel in right of body, as on full-size wagons. Third seat (shown) is an $80 option. Montego spare wheel (above) stores the same way. Rear-facing third seat is $67. Tailgate step-in is high on all three cars.



Most complete instrumentation is found in Coronet, with all dials and gauges in the right place. Montego (center) carries only speedometer, odometer, and fuel gauge; provides only warning light for all the rest. Matador (bottom) is equally short of instruments. All the cars' dashes are well padded.

ity and ease of parking. We picked medium-price wagons from American Motors, Lincoln-Mercury, and Dodge, rather than the low-priced Chevy, Ford, and Plymouth. We wanted to include a Pontiac Le Mans —in the same category and price range —but none was available due to the GM strike.

The test cars came with typical equipment: automatic transmissions, power steering (a must!), power brakes, power tailgate windows, roof racks, and a number of popular comfort and convenience items. We put the cars through our full test program, and can now report:

- How they compared in braking.
- Which wagon was best on *both* acceleration and fuel economy.
- A spare wheel we almost couldn't find.
- Some baffling design flaws in the interiors.
- Which tailgate proved best to us.
- How the cars compare on ease of interior conversion.

AM's Matador. It's the shortest of these wagons and—though it doesn't quite match the Coronet for cargo areas—it has all the interior space of the full-size Ambassador: Cargo length (at floor) 92.63 in. Cargo width (to wheelhouse) 45.08 in. Cargo height (max.) 31.72 in.

As a two-seat wagon, it offers an under-the-floor storage compartment of eight cubic feet.

The Matador has a two-way tailgate, operated by two separate handles. Full width of the car is available for cargo. There is a lockable storage compartment under the floor. The spare wheel is also stored under the floor (a wrench is needed to get to it; we'd prefer a wingnut). Folding the second seat is a two-man job—release latches at the sides are unconnected.

The Matador has modern, theft-proof, inside door locks. Vent windows in the doors provide positive ventilation, and there are air vents in the kick panels on both sides. Small controls are well identified and easy to reach. The glove box is large, and the lid opens fully.

The engine gives truly superlative performance. The Matador beat even

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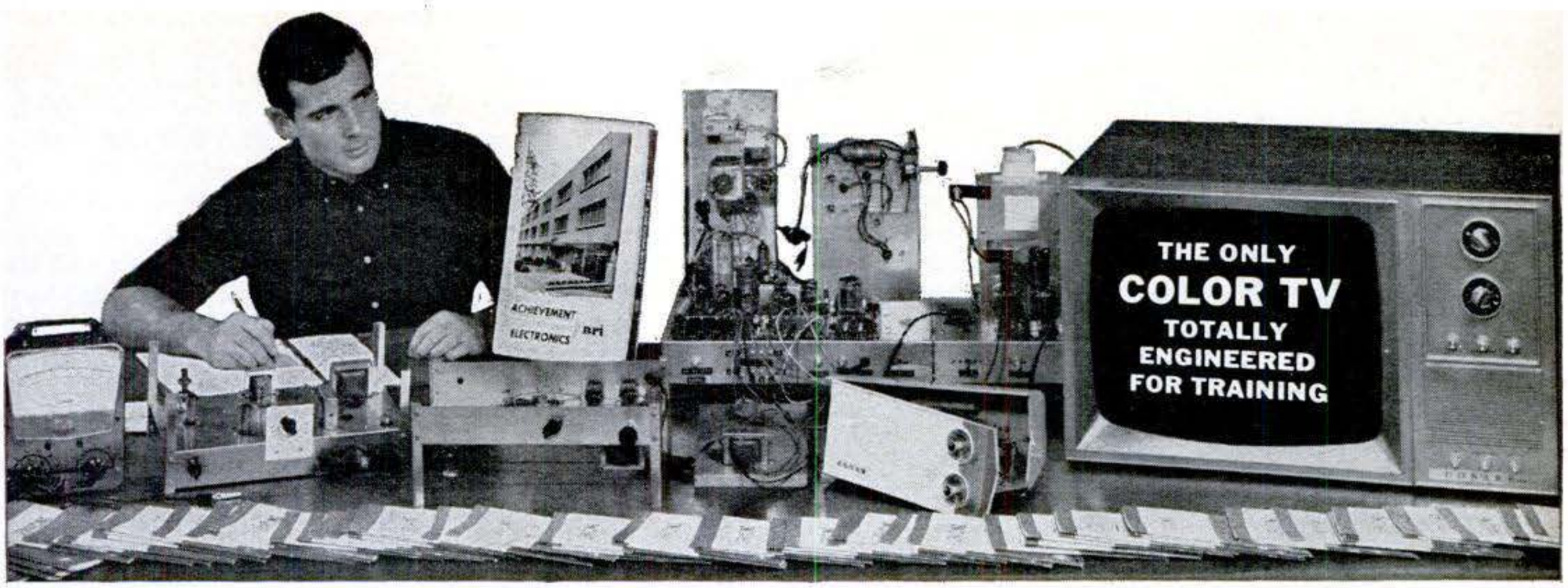

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the Dodge on acceleration from standstill, and led both of the other cars by a wide margin on gas mileage. It doesn't have the high-speed handling precision of the Ford and Chrysler products, but is comparable in low-speed maneuverability.

Coronet Crestwood. The Dodge, with its new fuselage-look, appears and *feels* like a very big car. Seating dimensions nearly match those of the other wagons, but there's more cargo space. There is under-the-floor storage even when the third seat is folded (as a two-seat wagon, a compartment of nine cubic feet). "Flower boxes" along the windowsills on both sides take small packages.

The tailgate is a two-way type. We found its Unilock handle inconvenient to use. A useful option fitted on our test car was the remote tailgate lock controlled by the driver.

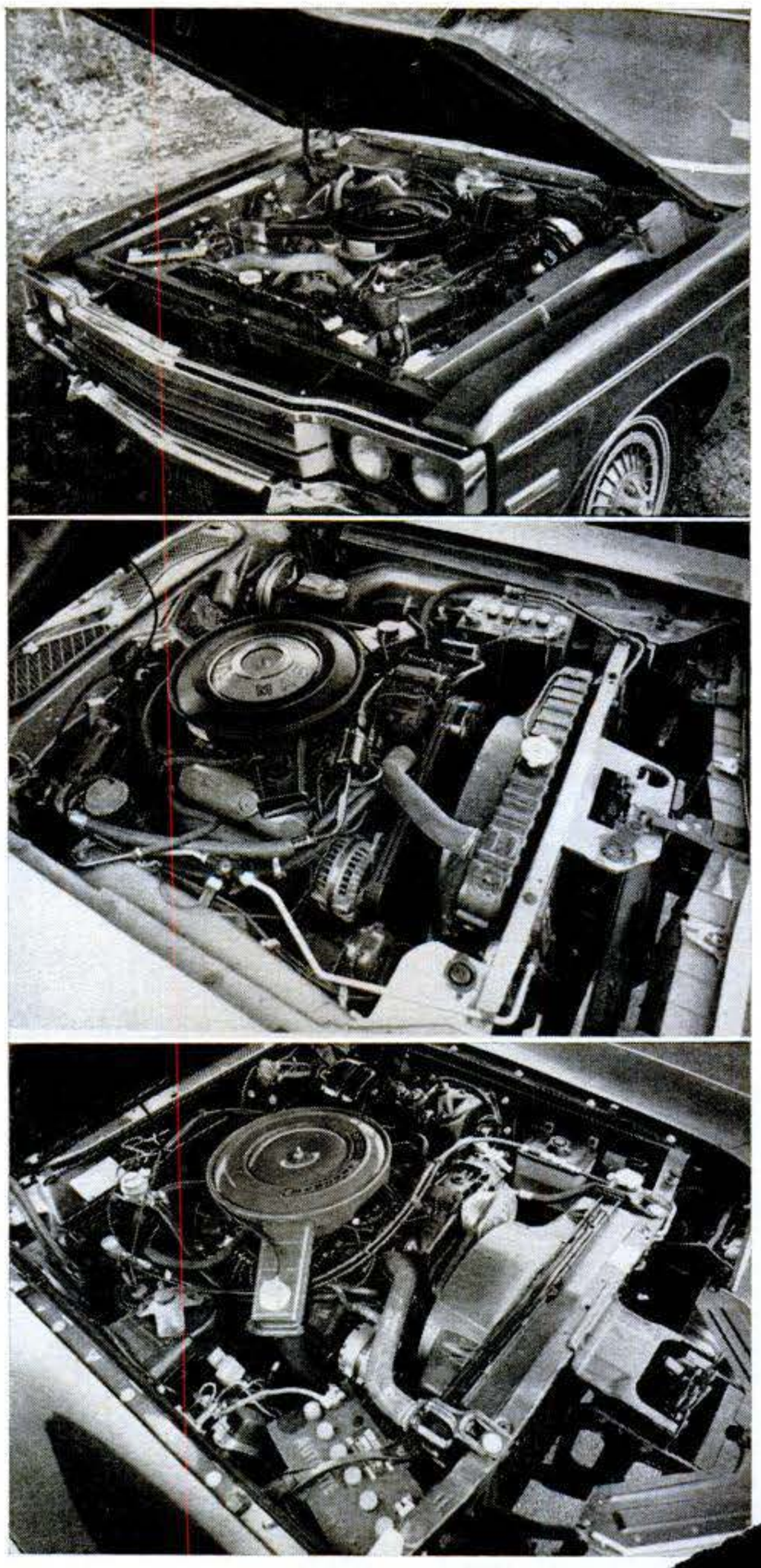
Folding the second seat is a simple one-man operation, giving a load platform slightly too short to take a 4-by-8 plywood panel. Rear-window wiper/washer is an option. We recommend it, although our test car had none. The air deflector keeps the rear window clean longer than on cars without such deflectors.

The front seat is lower and the top of the instrument panel is higher than average. It gave us a sunk-down, closed-in feeling. Instrumentation is unusually complete, and the speedometer is in its best position (near 11 o'clock on the steering wheel). Gauges and small controls are simple and easy to understand.

The steering-wheel spokes, however, hide the radio and A/C controls. Both radio knobs are at left of the dial, causing "station breaks" when you only want to turn volume up or down. The parking-brake release is practically at ankle-level—an inch or two higher than the brake pedal.

The Chrysler power steering has a numb feel. The steering wheel gives you little feedback information on what tires are doing on curves. You miss the feel of how much of the car's cornering ability you are making use of. The power steering also suffers from pump catch: Quick steering reversals result in a loss of power assist.

The brakes on our car faded badly. They lost effectiveness after repeated stops. We do not think our test too tough. We test with two men in the car and about 25 pounds of equipment; wagon owners usually carry far greater loads. And our 10 warmu stops, a minute apart, a hardly worse o brakes than st bumper-to way t



Matador has excellent underhood accessibility (cept for the awkward position of the oil filte (center) has spark plugs hidden below hot ex fold on both sides. If you clean your own do it with a cold engine! Montego engin (bottom) is very crowded. Right-bank plug

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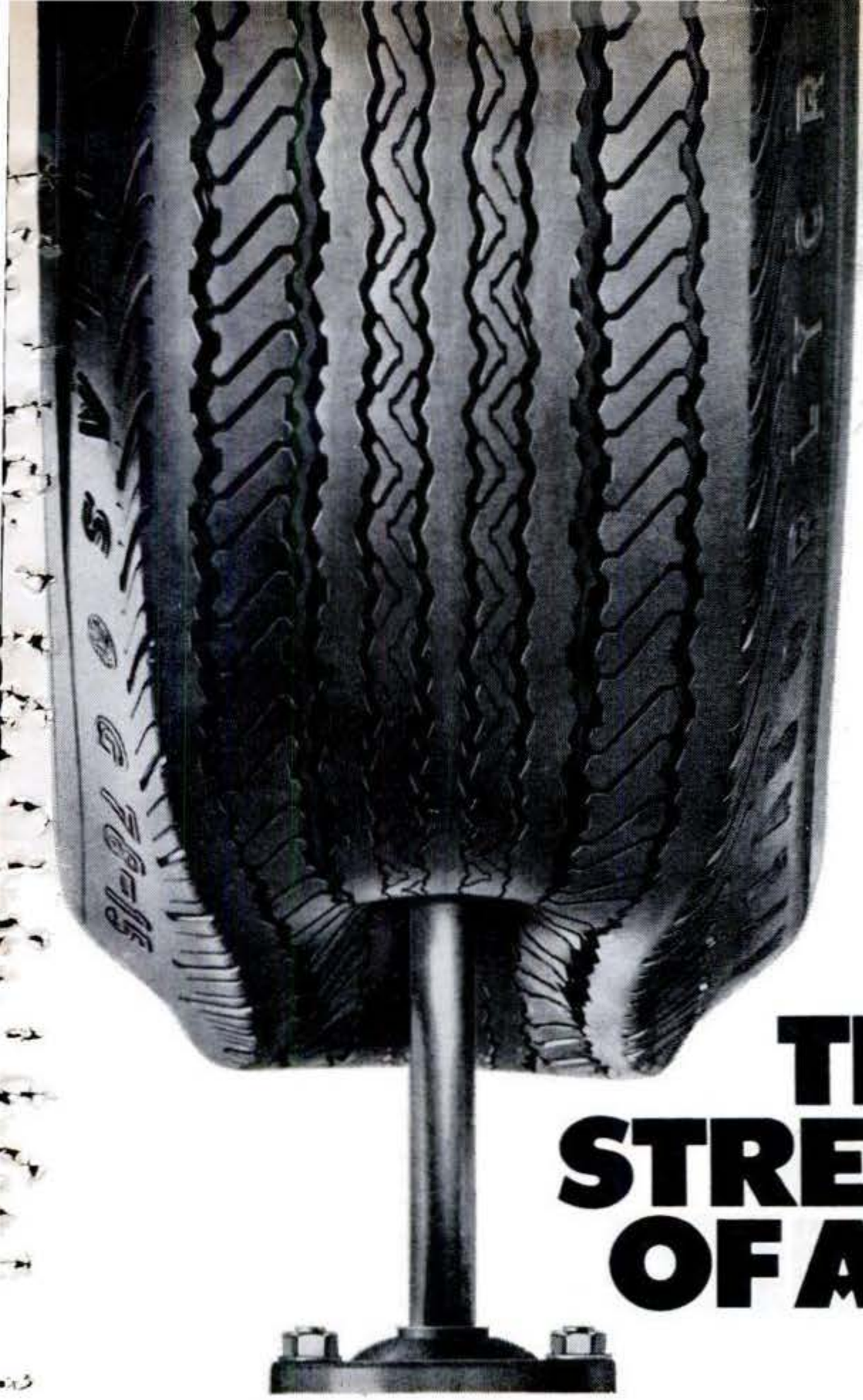

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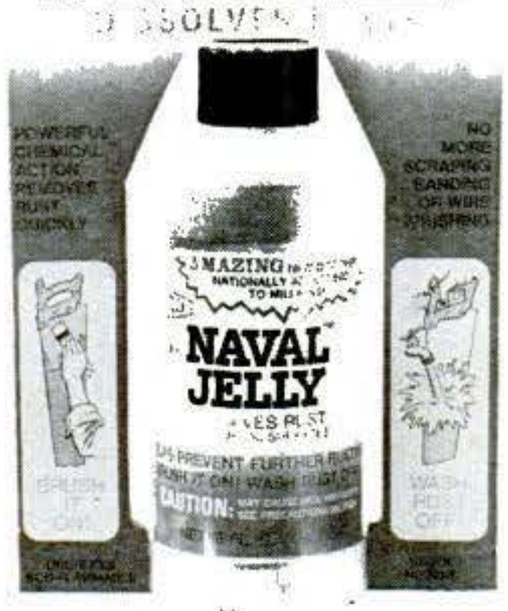

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Montego, shown in brake test, had shortest stopping distance, lowest pedal pressure.

Coronet (left) and Montego stopped here from 60, with same-point brake application.

Montego MX Villager. This is the smallest of the intermediate wagons, but not necessarily the least practical. It is a wagon, and has all the usual wagon features. And cargo space is quite impressive: length (at floor) 89 in., width (to wheelhouse) 42.6 in., height (max.) 32.6 in.

This Mercury has lots of storage room in the third-seat floor well, and the compartment locks for security against thieves. Without the third seat, the compartment holds 7.6 cubic feet. The second seat can be lowered from one side by one person. Folding and raising the seat is not difficult. There is a two-way tailgate.

The car has a solid, tight feel that gives the impression of quality. The Montego also feels smaller than it actually is. Vent windows in the front doors provide positive ventilation and are easy to unlock and open. Heater and A/C controls are not precisely marked, and are difficult to read and to set in correct position. The glove-box door falls on your knee when you open it, and you can't see inside it unless you bend over.

The other wagons came with four-barrel carburetors, but the 351 V8 "Cleveland" engine was only available in its two-barrel version for the Villager. As a result, the Montego is low in performance compared with the Coronet and Matador. The strange thing is that it shows only a slight advantage over the hot four-barrel 383 Dodge, and fails to match AM's robust 360 on fuel economy.

The Mercury's strong point is its excellent fade-free brakes. Not only did it have the shortest stopping distance, but pedal pressure remained low after 10 warmup stops. Nose-dive on hard braking is strong, but there is no threat to the wagon's stability. Remarkably, there was no rear wheel-locking when the front wheels were just short of lock-up point, even with

Continued

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	Dodge	Matador	Mercury
30 mph smooth road	64 dbA	63 dbA	62 dbA
60 mph smooth road	73 dbA	74 dbA	72 dbA
30 mph rough road	75 dbA	76 dbA	74 dbA

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Ground clearance of Dodge (left) is lowest, Matador highest, and Mercury in between.

the car carrying no load in the back.

Conclusions

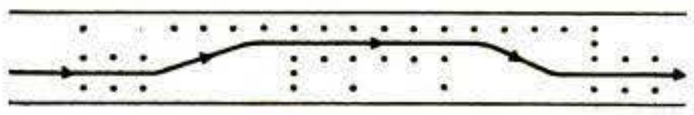
Dunne: The Montego is my choice. It's a convenient all-around utility car that offers you great comfort and security for any type of driving.

Norbye: My vote goes to the Matador. It's tops in practicality and space utilization, goes like blazes, stops well, and is easy on the gas. PS

How PS tests cars—and what the tests show

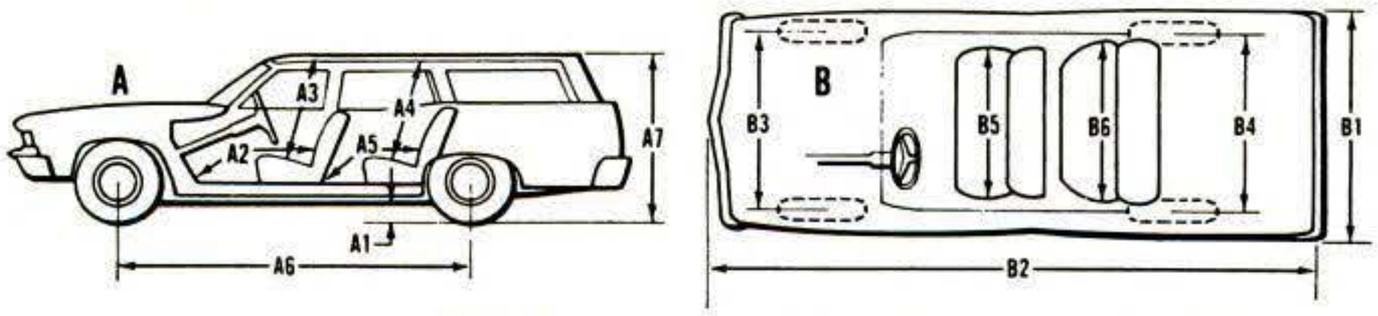
Brake test shows a car's ability to stop on a straight line from 60 mph, without locking any wheels, after 10 stops from 60 at one-minute intervals with ½g deceleration (normal quick stop.) Final stop is made in a 12-foot-wide lane and stopping distance is measured. Excessive pedal pressure indicates fading brakes. Excessive distance indicates fade, locking, or both.

Acceleration test at 0-60 mph shows a car's ability to reach cruising speed from standstill. The 0-80 mph test shows its high-speed power reserve; 25-70 mph test simulates a highway merging situation. Cars with automatic transmission are tested in DRIVE.



Two lane changes in quick succession show a car's ability to make an emergency maneuver at speed. Lanes are blocked 120 feet apart, and lane-change gaps are 60 feet long. Each car is put through test at increasing speed until its maximum is established.

Low-speed emergency maneuver test means snaking a car as fast as possible through pylons 48 feet apart. In both handling tests, times clocked by two stopwatches are converted to mph.



DIMENSIONS (inches)	DODGE Coronet Crestwood	MATADOR station wagon	MERCURY Montego MX Villager
A1 Ground clearance	4.7	6.6	6.0
A2 Front leg room (max.)	42.2	41.8	41.0
A3 Front head room	39.7	39.9	38.2
A4 Rear head room	39.9	38.7	39.0
A5 Rear leg room (min.)	36.7	38.6	34.4
A6 Wheelbase	118.0	118.0	114.0
A7 Height	57.4	56.4	56.1
B1 Width	78.7	77.2	75.4
B2 Length	213.4	205.0	211.8
B3 Front track	60.1	59.7	60.5
B4 Rear track	63.4	60.0	60.0
B5 Front hip room	59.2	60.3	59.0
B6 Rear hip room	59.2	60.4	59.5
SPECIFICATIONS			
Engine type	OHV V8	OHV V8	OHV V8
Bore x stroke	4.25 x 3.38 in.	4.08 x 3.44 in.	4.00 x 3.50 in.
Displacement	383 cu. in.	360 cu. in.	351 cu. in.
Compression ratio	8.5:1	10.0:1	9.0:1
Carburetion	one 4-bbl.	one 4-bbl.	one 2-bbl.
Horsepower @ rpm	300 @ 4,800	290 @ 4,800	240 @ 4,600
Torque (lb.-ft.) @ rpm	410 @ 3,400	395 @ 3,200	350 @ 2 600
Transmission	TorqueFlite	Shift Command	SelectShift
Axle ratio	3.23:1	2.87:1	2.75:1
Tires	Gdyr. Polyglas	Gdyr. Polyglas	B. F. Goodrich
Tire size	H78-14	G78-14	G78-14
Turning diameter	40.8 ft.	39 ft.	42.3 ft.
Turns, lock to lock	3.5	3.2	3.5
Brakes	power: disk/drum	power: disk/drum	power: disk/drum
Fuel tank	21 gal.	19.5 gal.	18 gal.
Curb weight	4,306 lbs.	3,755 lbs.	4,205 lbs.
TEST RESULTS			
Acceleration 0-60 mph	9.4 sec.	9.3 sec.	11.8 sec.
Acceleration 0-80 mph	16.2	15.1	21.5
Acceleration 25-70 mph	10.2	10.4	13.0
Braking distance 60-0 mph	227 ft. 4 in.	160 ft. 3 in.	141 ft. 1 in.
Brake pedal pressure	200+ lbs.	200+ lbs.	75 lbs.
Max. speed—lane change	48.2 mph	43 5 mph	46.6 mph
Max. speed—traffic weave	24.0 mph	23.5 mph	23.0 mph
Average fuel mileage	10.29 mpg	13.2 mpg	10 76 mpg
Price (basic)	$3,105	$3,163	$3,469
Price (as tested)	$4,577	$4,661	$4,749

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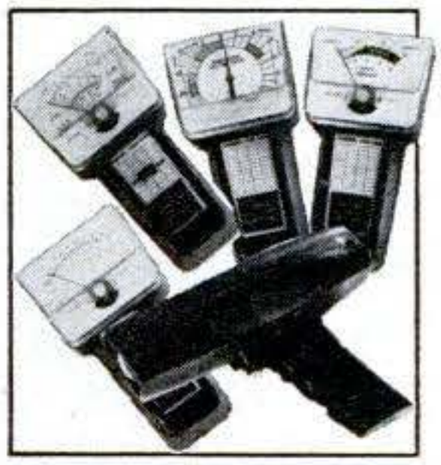

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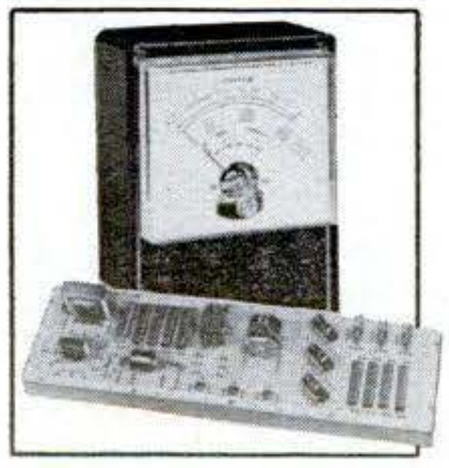

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My 1968 Valiant 273 V8 engine frequently cuts out (falters, staggers, etc.) for about three or four seconds on a left turn; sometimes on a right turn or going uphill. The dealer has rebuilt the carburetor, tuned the engine, and checked for bad electrical connections several times but nothing seems to solve the problem.

BARNEY BARNES, San Diego, Calif.

This could be a weirdo deal but I'll take a shot at it. Hard turns or going up steep hills all give the carburetor fuel bowl an angle. So it could be that the float level is too low and that you are uncovering jets in these situations. The quickest way to find out is to raise the fuel level a sixteenth of an inch and see if that doesn't help.

My 1970 Ambassador 360-inch, 2-bbl V8 is supposed to use regular gas, according to the manual. I used Esso Plus from the beginning because I was afraid the lowest would be too low on octane. It ran fine until a couple of weeks ago when they came out with Big Plus. Since then it usually knocks on a load, like uphill from a slow start. It never knocks when first starting with engine cool. Can the carburetor or other settings be adjusted to take this fuel without knocking? My last 10 gallons were Esso Extra and I haven't had a knock on it. But won't continued use of Extra be harmful, since I'm supposed to use regular grade?

W. L. RICHARDS, Severna Park, Md.

I think that you might be able to get around your problem by retarding the timing a little—though it will have to be a cut-and-try deal. But if this doesn't help before you lose a lot in performance, then use Extra until you stop the knocking. Knocking will ruin the engine. You could also experiment around with other trade names and possibly find a regular-grade gas that will work out.

Two questions please: 1) I drive a 1969 Pontiac 350 V8 automatic. We often park on a 15-degree inclined driveway. The hand brake barely holds, but the Park pawl does. Is this safe? Is there a rule-of-thumb answer as to the slope you can park on this way? 2) My son drove a 1968 Falcon van 1,700 miles almost nonstop and boiled the battery nearly dry. A mechanic says the battery was faulty, although barely two years old. I blamed the voltage regulator. Would you care to comment?

BEN CRAWFORD, Orillia, Ont.

On the Pontiac, get that emergency brake fixed. The parking pawl in your transmission won't put up with that abuse too long. On your son's Ford, assuming the battery was full of water at the start of the trip and boiled dry, my guess is that the charging system was too high, or simply did not cut out when voltage reached the desirable limit. If the regulator checks out okay now, then you can blame the deal on the battery not being full of water at the start.

Rebuilding the four-cylinder engine in my '57 Hillman Minx, I replaced the clutch plate, cover assembly, and throw-out bearing with rebuilt parts. But now the clutch slips on acceleration in third and fourth. There's no grease or oil on the surfaces, parts are the correct size, and there's enough play in the throw-out bearing adjustment so that it can't be putting constant pressure on its contact surface. The pedal has the correct adjustment, the springs in the cover assembly aren't weak, and the flywheel surface is good with no evidence of warpage. It worked fine with the older (and thinner) clutch plate and assembly. Can you help?

ALAN I. LAMPSON, Seattle, Wash.

Find out, if you can, whether you have at least 1/8" clearance from the throw-out-bearing face to the pressure-plate fingers when it's not running. If you have that clearance, start taking out the clutch again. Either the pressure plate is weak, or you have a clutch disk of the wrong thickness. You simply don't have enough clamping pressure on the disk.

Please help me find and fix a shimmy or vibration in my '69 Mercury Marquis. Neither my garage nor I have been able to solve this. So far, here's what we've done: Replaced the right-rear axle and bearings, right-rear brake drum, front and rear outer bearings, the drive shaft with new one-piece shaft, transmission sleeve for drive shaft, and all shock absorbers with heavy-duty type. Wheel rims were checked for trueness and alignment, and all tires replaced with what Firestone calls "known-quality" tires. There is still one tire that seems to have a moving balance point, but not enough to warrant replacement. Vibration persists at all speeds, but is more pronounced at 30 and 60 mph and is compounded when you hit a hole. Mercury's representative says that the tires are at fault. What do you say?

RICHARD E. WILKERSON, Norfolk, Va.

One big thing you haven't done is to true the tires. Take it to a shop with a Kem Truer, or similar machine and have your tires trued and balanced on the car. If this doesn't do the trick have the drive shaft removed and run the engine in gear and see if the engine or transmission assembly has the vibration without the driveline included. Assuming that it doesn't, go back to the drive shaft and have its balance checked. If you haven't located the trouble by now, reconsider what the factory rep said. See if your dealer can borrow a set of wheels and tires from an okay car, then try them on yours. You'll find the fix.

An avid racing fan, I'd like to build a two-seat sports car about as long as the old roadsters. I would like to use chrome-moly tubing and Halibrand equipment front and rear. Would I be able to balance it properly? If I use a sprint-car steering mechanism would it cause problems getting it to work? What about the size of the rear end and front end? What size frame tubing is best? I expect to conform with the law, not wanting to build some kind of a monster. Just for sensible speeds. Who might let me use Old Champ car blueprints? Any advice will be appreciated.

R. J. WALSH, Beloit, Wis.

Now whoa there! You have just asked me what it took me 25 years to learn with a lot of help from the best engineers in the world—and I'm still learning. So how could I answer it all here? So far as to where you might get some Champ blueprints, I'd suggest Dan Gurney's All American Racers in Santa Ana, Calif., or write A. J. Watson at Indianapolis Motor Speedway. You might do some good either place.

The four-speed transmission in my 1970 Chevy Blazer is very stiff, even after 14,000 miles. It shifts okay into second and fourth, but not into third and reverse. Driving in heavy city traffic, it shifts extra hard. I've had it back to the dealer several times, but he claims there is nothing they can do about it. Although the Blazer is new in the Chevrolet line, GM has been making transmissions for years—why foul up now?

BERNARD BASSETT, Athol, Mass.

This is not a chronic complaint, so have some checking done. First have the clutch checked for complete release; it could be dragging. Then, assuming that is okay, go to the shift linkage for angles and adjustment. If those are all right without relief, then the trouble is internal. The transmission will have to be removed and disassembled for inspection to show up the trouble. I think you'll find the trouble is mainly clutch release, and improper linkage adjustment and lubrication.

Continued

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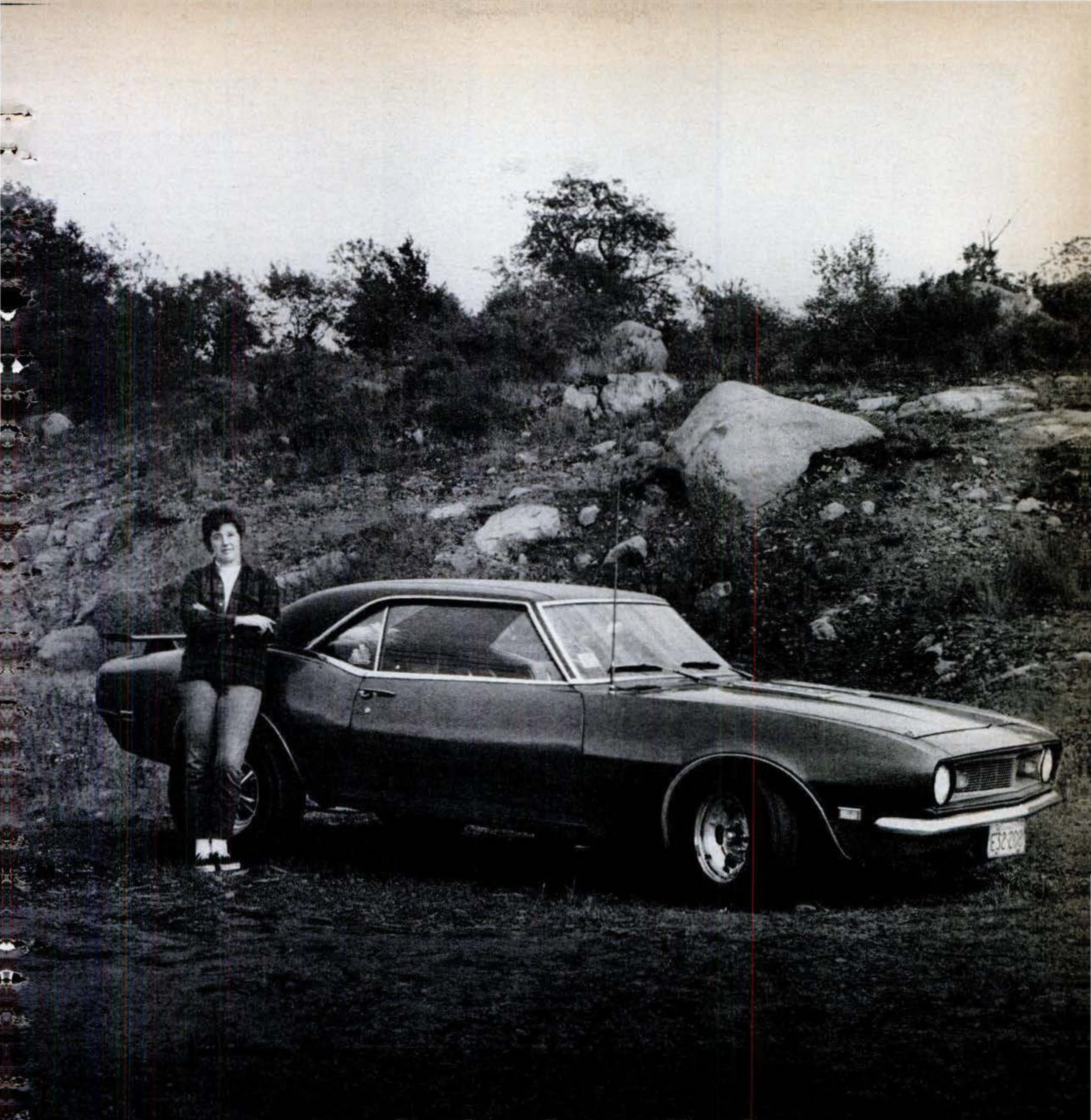

Ann is a lovely mechanic.

Ann Marsh is just as much at home under a hood as over a hot stove.

And just as pretty. As you'll find out if you stop at her service station in Gloucester, Massachusetts.

When Ann bought her 1968 Camaro for $200, it was a total wreck.

She helped rebuild the car, then painted it mauve and put in a set of Champion Spark Plugs.

"My husband uses Champions," Ann says, "so I use Champions."

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7 million Chevrolet owners have switched to Champion Spark Plugs. This has been one of them.

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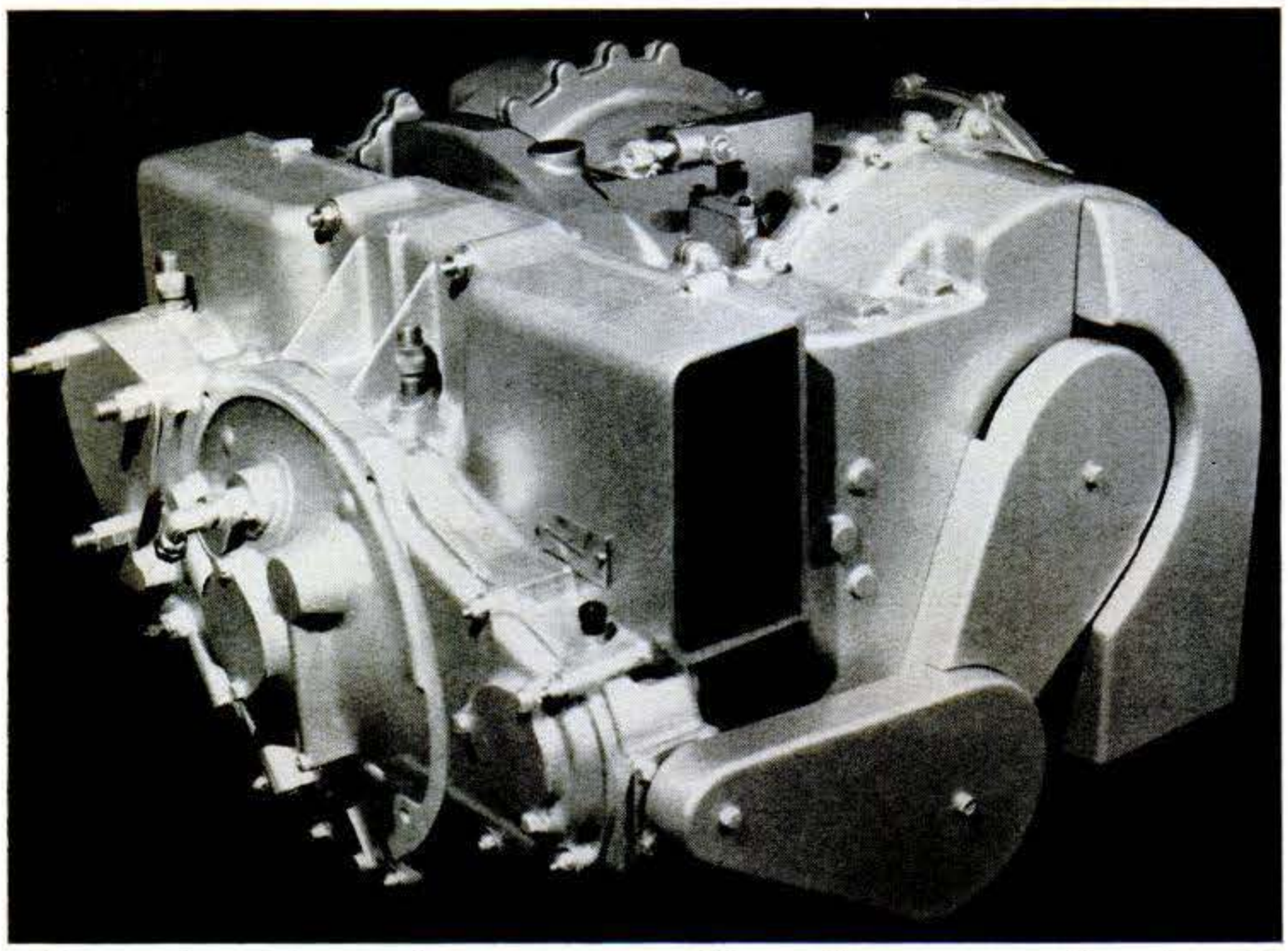


Williams turbine delivers 80 hp at 4,450 rpm, weighs 250 lbs., measures 26-by-24-by-16 in.

Tiny 80-hp Gas Turbine to Power Compact Car

By **JAN P. NORBYE** / *PS Automotive Editor*

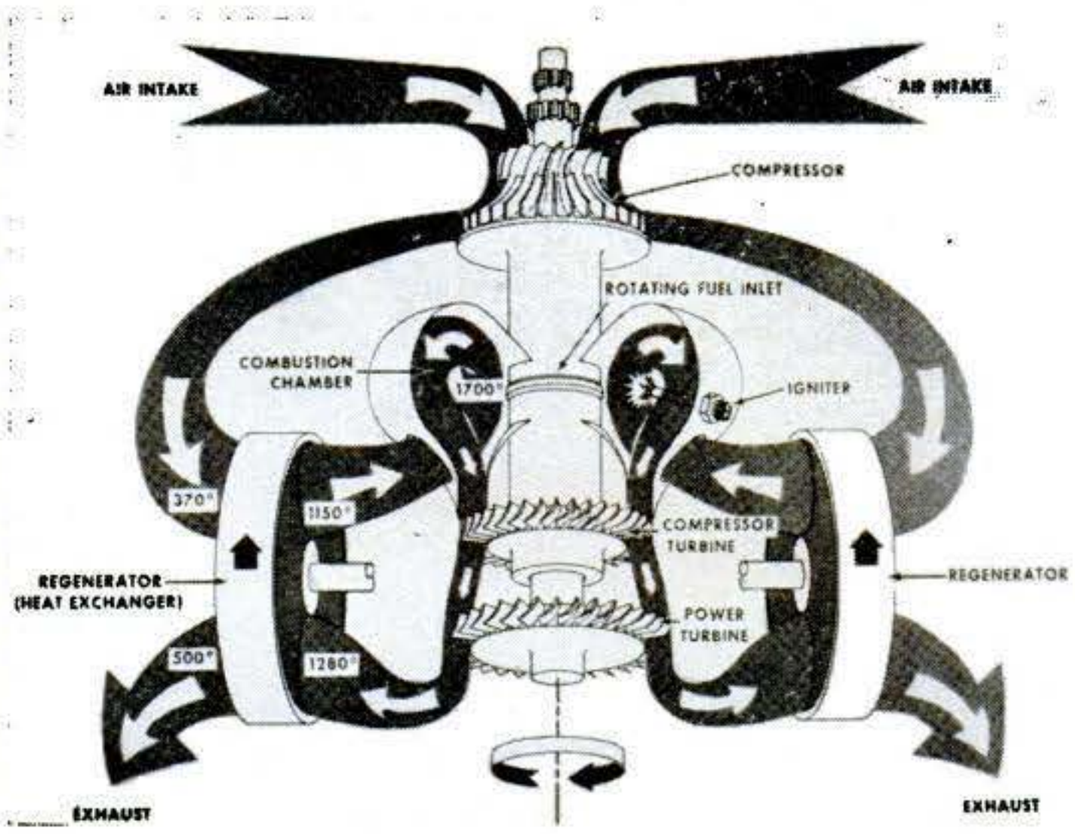
You hadn't forgotten the gas turbine, had you? It's an exciting potential power source for future zero-emission automobiles. With more promise than the piston engine, it's a serious rival to steam and electric power.

Williams Research Corp., of Walled Lake, Mich., has developed this 80-hp turbine for installation in a Hornet—under contract from New York City through a grant from the National Air Pollution Control Administration.

Why is the turbine's exhaust gas so clean? First, the combustion is continuous, so that the chamber walls never cool off. Thus there is no quenching, as in a piston engine, and as a result the combustion process is more complete, with fewer unburned hydrocarbons left over.

Second, gas turbines use large amounts of excess air and thus dilute the combustion products to low concentrations. Still, Sam Williams, who designed and developed the turbine, is the first to point out that considerable work remains to be done before his turbine will meet "desired levels" (the 1975 Federal Emission Control Standards). Within a year, the car will be delivered, and tests will show how well it demonstrates the turbine's ability to provide low-emission power for urban driving.

Air enters the compressor and is forced through two rotary heat exchangers on its way to the combustion chamber. The heat exchangers utilize exhaust-gas heat to warm up the fresh air and cool the exhaust gases before they escape into the atmosphere. After combustion, the expansion forces work on two turbines, in series. Primary turbine drives compressor and engine accessories. Secondary turbine, which has no mechanical connection with first, drives output shaft (which will drive car).



"Say, Smokey—"

[*Continued*]

I have a 1966 Buick Sport Wagon that is difficult to get started first thing in the morning. Once started, though, we have no difficulty the rest of the day. Could it be that the gasoline has drained out of the carburetor, and has to be pumped up each morning? Would an electric fuel pump overcome this difficulty, and would you suggest installing one?

G. H. BROWN, Baton Rouge, La.

Forget the electric pump. Get a good carburetor man to check all carb specs, especially the choke, to be certain it is in proper position. Then touch base with your owner's manual on starting a cold engine. You might also have your ignition checked to see if the coil gets enough voltage when the engine is being started.

I am thinking of buying J. C. Whitney's Fire Injector fuel ignitors for my 1970 GTO; the reason being that after a couple of weeks of town driving my car starts to miss and cough at high rpm. They claim Fire Injectors won't foul up because of the continuous type of electrode. Is there any truth to this? There is a very limited number of heat ranges for the Injectors. What effect would this have on my engine? I've always understood that the heat range was very important for proper performance.

JAMES C. DIEFENBACH JR., Ames, Iowa

Stick to recommended series-gap spark plugs for your engine, along with the type of service. If you drive hard, get the cooler recommendation. If they still foul up you have engine trouble. I know the car is nearly new, but maybe it's an oil leakage problem around rings or valve guides.

I bought a 1962 Olds wagon with automatic transmission. Before doing so, I tested it by driving three times down a long steep hill on compression—that is, with the throttle closed. On opening the throttle I expected lots of blue smoke. There was none, so I bought the car. As the oil in the crankcase was very black and dirty I changed oil and put on a new filter. It immediately smoked generously! Problem No. 2: Mechanics tell me that the front flywheel, where the timing mark is located, is mounted on rubber, and it has slipped so that timing by light is impossible. So how? Problem No. 3: The transmission shifts directly from *low* into *third*, skipping *second* unless under heavy load. But to start in *'S'* produces a jolt so I start in *'D'*, and let up on the gas at 15 to 20 mph, whereupon it shifts into *third* easily. Aamco found no reason to spend my money—but . . . ?

JAMES W. WORK, San Diego, Calif.

1) Heavy oil works as a hydraulic seal; the new oil being less viscous lets some get by the rings and valve stems. 2) If your front damper has slipped on the rubber, replace it before it goes through the radiator. Also, it throws your engine off balance. 3) Sounds like a defective valve body and a gummed-up governor. Try "chemistry," and in case of no results, the only fix is to operate.

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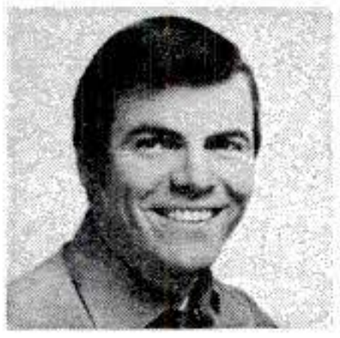

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Detroit Report...

CHRYSLER SHELVED ITS R-429 MINICAR in December--preparing it for production would cost $80 million, says one company source. Also, Chrysler wants to get a reading on the popularity of the Cricket and the Colt. Though less than 40,000 of these small cars from England and Japan will be imported this year, Chrysler will watch their market performance against the Pinto and the Vega very closely. If they are successful, the R-429 will be delayed even longer.

Ford has cancelled some future styling programs. The Lincoln and other big Ford Motor models were set for extensive sheet-metal changes in '73, but the program has been trimmed severely. Ford's decision is the latest in a series of new-model cutbacks, including Chrysler's cancellation of the 1971 big-car program (Chrysler, Dodge Polara and Monaco, and Plymouth Fury are practically unchanged from '70), and GM's pullback on the '72 intermediate lines, which were due for total renewal. Ford's decision was based partly on the Chrysler and GM moves, but mainly by uncertainty over bumper requirements for 1973 and later cars. Shock-absorbing bumpers may be mandatory for '73, and Ford would rather develop that type of bumper for its existing models than for an entirely new line of cars.

First of the new bumper designs to protect a car in low-speed impacts will show up later this year. Oldsmobile will fit '72 models with spring-steel bumper hangers (instead of the mild-steel supports now in use). Olds is fighting the other GM divisions to win this feature exclusively for one year. It's still Pontiac that offers you the best protection. Its Endura bumper is years ahead of anything else now in use.

The '72 Gremlin is getting extra attention from stylists. Right now the rear-quarter panels are considered too wide, making the car look heavy and ungainly. American Motors plans to soften the rear end by adding bright trim and extending the paint stripe to the area. Yet, AM doesn't want to change the car too drastically. Its unique shape is highly visible, as they say in marketing circles, and that's a valuable selling asset. Actually, the Gremlin was not designed with that wide "sail" as a prototype. But the engineering department requested a last-minute change—they wanted more body length to cover up the rear springs and, as a result, the sheet metal was extended three inches.

A new disk brake, made of steel instead of cast iron, will begin to show up on new cars in the next two years, and may eventually sweep the industry. The steel rotor weighs eight pounds less than a current cast-iron one. The new rotor can be stamped out of steel blanks, a manufacturing shortcut that should cut costs by at least 20 percent. But most importantly, the steel brake has an enormous capacity for dissipating heat. That means that it will be virtually fade-free in most standard brake tests. And, because the disk runs cooler, the pads will last longer. Another benefit is the reduction of unsprung weight, which will improve roadholding and controllability. Both Ford and Chrysler are interested. One holdup is that the brake manufacturers have big investments in facilities for making cast-iron rotors. They are naturally reluctant to scrap their iron foundries and build new plants to stamp steel disks.

A revolution in car-body design, caused by the growth of air-conditioning sales, will take place in the next few years. Now on test at the GM proving grounds are cars with a partially sealed passenger compartment. Rear side windows do not roll down, but swing outward, similar to the VW design. Joints between the glass and sheet metal are aircraft smooth. Eventually, designers hope to seal all windows except two small service windows in the front doors. The cost savings on nonretractable windows is about equal to the cost of an A/C unit, and product planners see this as a desirable trade-off in future models.

"Foreign cars have better brakes," says Doug Toms, the government's top safety director in a comparison of U.S. and foreign cars. Toms—the man responsible for all automobile safety direction—bases his conclusion on the stopping-distance figures submitted to the government by all car makers. The U.S. cars show up very poorly. The Pinto, top-ranked domestic in the government list of braking effectiveness, follows 17 foreign cars. Ahead of the Pinto are models from Alfa-Romeo, B.M.W., Sabaru, Rolls-Royce, Porsche, Mercedes, Citroën, Fiat, Renault, Jaguar, Saab, and Peugeot. Topping the list is the DeTomaso, Italian sports car, that stops in 130 feet. Worst is the V8-equipped Hornet that takes 263 feet to stop from 60 mph under government conditions.

Big cars will get smaller in the near future. If for no other reason, safety and smog laws will force the change on car companies. And smaller cars will also shrink in size. Bumpers that extend up to a half foot past the sheet metal of new models will dictate a smaller car package. You can't add six inches to the length of present cars without revolutionizing a number of driving parameters. Parking, especially, will become a problem of gigantic proportions unless car length is held in check. Adding to the weight of future cars are those 40-lb. side-impact beams in the doors. Engineers are already trying to take this much weight out of other areas.

Pontiac's "V8 engine of the future" is made with a number of obsolete features. The experimental aluminum-block engine, according to Pontiac, can develop upwards of 640 hp, weighs 40 percent less than an iron one of its 427-cu.-in. size. But, it has obvious errors and it is puzzling to see Pontiac engineers take a backward step in aluminum-engine design at a time when their reputation for leadership needs new support. For one thing, the experimental engine is sand-cast, a metal-forming process abandoned by GM in production cars many years ago. In contrast, Chevy's Vega has a die-cast aluminum block, a design that Chevy describes as "the only way to go." Pontiac's V8 has the now-outdated iron liners on its cylinder walls that made aluminum engines too costly for high production until the problem was solved in the Vega engine. Pontiac says the engine won't be mass-produced anyway.

Steam engines got another setback from a General Motors research team. After testing two designs for steam engines in GM cars, the team reported that emissions of nitrogen oxides exceeded proposed 1975 standards, fuel economy was five mpg, and performance unacceptable in today's traffic. Also, their engines proved difficult to service, and reliability a serious problem. On the plus side, it was found that the steamers were easy to build, used mainly inexpensive materials, and produced low-level carbon monoxide and unburned hydrocarbons. Not mentioned was the extra noise when the boiler is being fired. The heater makes a sound like a giant blowtorch that's even more obtrusive because it goes on and off frequently while the car is running.

Don't wait for the auto industry to change to the metric system to help alleviate service problems. It is just not needed, says the Automobile Manufacturers Association. Presently, there is little use of metric measurement and metric-based engineering standards in U.S. car building. What's more, the Association sees no need for a mandatory program to convert now. They suggest that the most efficient course is to permit gradual acceptance of the metric system as circumstances require it in the U.S. However, Pinto, Vega, Colt, Cricket, and American-owned imported cars all require metric tools for repair or disassembly.

Jim Dunne

Detroit Editor

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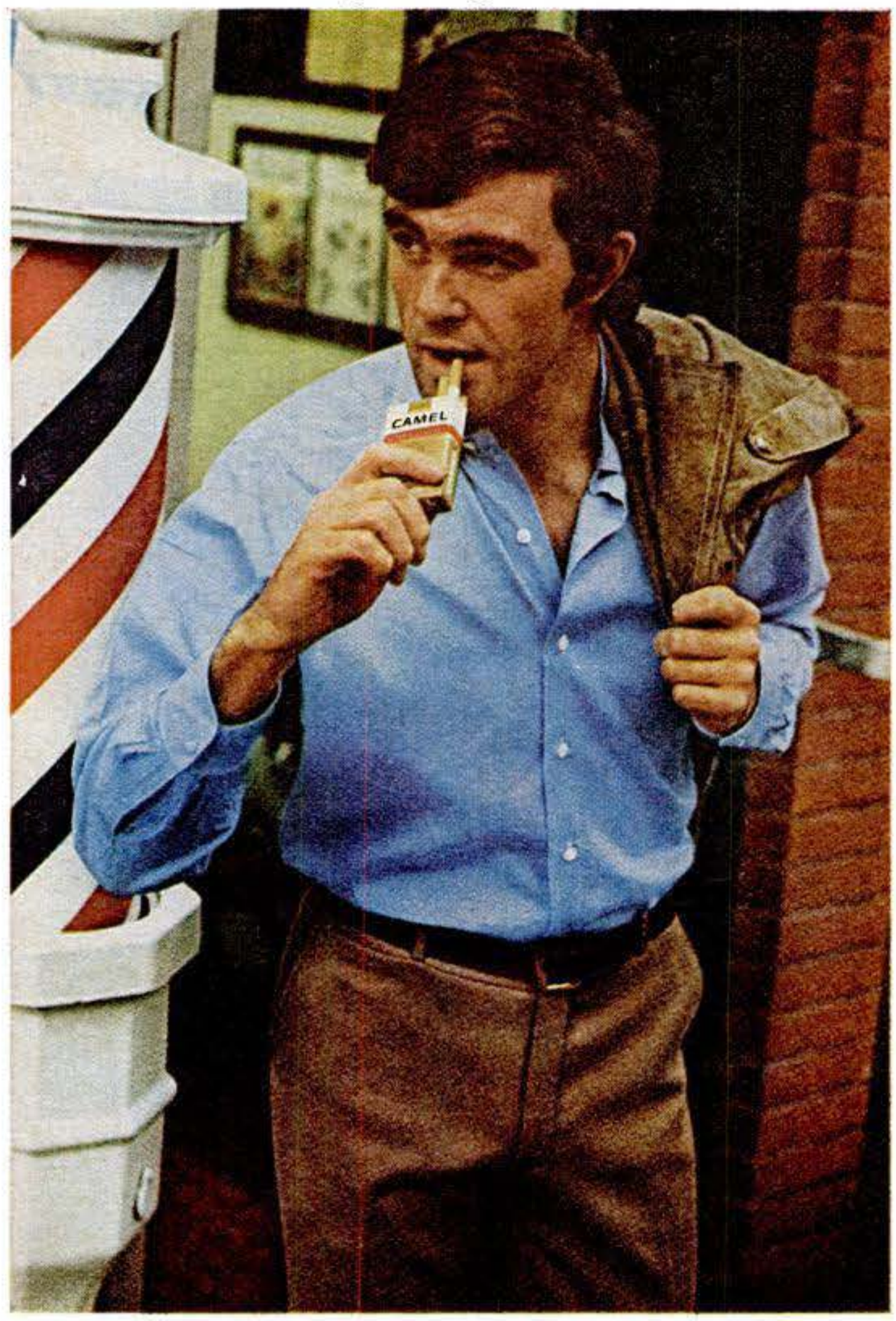
Mr. Victor suggests a much longer cigarette to go with his new hairstyles.

Now everybody will be smoking longer cigarettes to go with their new hairstyles

...almost everybody.



Camel Filters. They're not for everybody.

(But then, they don't try to be.)

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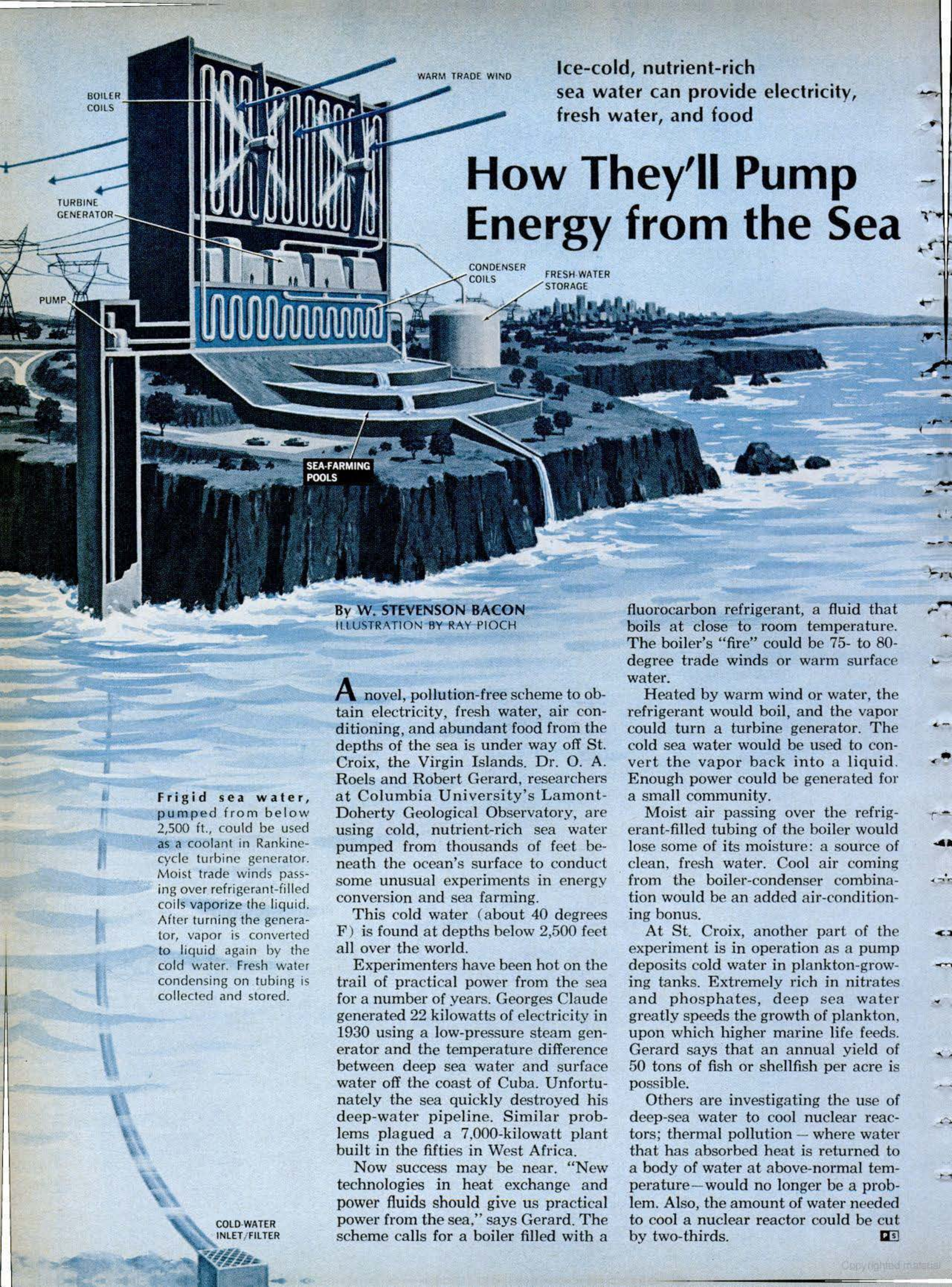
Ice-cold, nutrient-rich sea water can provide electricity, fresh water, and food

How They'll Pump Energy from the Sea



Frigid sea water, pumped from below 2,500 ft., could be used as a coolant in Rankine-cycle turbine generator. Moist trade winds passing over refrigerant-filled coils vaporize the liquid. After turning the generator, vapor is converted to liquid again by the cold water. Fresh water condensing on tubing is collected and stored.

By W. STEVENSON BACON
ILLUSTRATION BY RAY PIOCH

A novel, pollution-free scheme to obtain electricity, fresh water, air conditioning, and abundant food from the depths of the sea is under way off St. Croix, the Virgin Islands. Dr. O. A. Roels and Robert Gerard, researchers at Columbia University's Lamont-Doherty Geological Observatory, are using cold, nutrient-rich sea water pumped from thousands of feet beneath the ocean's surface to conduct some unusual experiments in energy conversion and sea farming.

This cold water (about 40 degrees F) is found at depths below 2,500 feet all over the world.

Experimenters have been hot on the trail of practical power from the sea for a number of years. Georges Claude generated 22 kilowatts of electricity in 1930 using a low-pressure steam generator and the temperature difference between deep sea water and surface water off the coast of Cuba. Unfortunately the sea quickly destroyed his deep-water pipeline. Similar problems plagued a 7,000-kilowatt plant built in the fifties in West Africa.

Now success may be near. "New technologies in heat exchange and power fluids should give us practical power from the sea," says Gerard. The scheme calls for a boiler filled with a fluorocarbon refrigerant, a fluid that boils at close to room temperature. The boiler's "fire" could be 75- to 80-degree trade winds or warm surface water.

Heated by warm wind or water, the refrigerant would boil, and the vapor could turn a turbine generator. The cold sea water would be used to convert the vapor back into a liquid. Enough power could be generated for a small community.

Moist air passing over the refrigerant-filled tubing of the boiler would lose some of its moisture: a source of clean, fresh water. Cool air coming from the boiler-condenser combination would be an added air-conditioning bonus.

At St. Croix, another part of the experiment is in operation as a pump deposits cold water in plankton-growing tanks. Extremely rich in nitrates and phosphates, deep sea water greatly speeds the growth of plankton, upon which higher marine life feeds. Gerard says that an annual yield of 50 tons of fish or shellfish per acre is possible.

Others are investigating the use of deep-sea water to cool nuclear reactors; thermal pollution — where water that has absorbed heat is returned to a body of water at above-normal temperature—would no longer be a problem. Also, the amount of water needed to cool a nuclear reactor could be cut by two-thirds. PS

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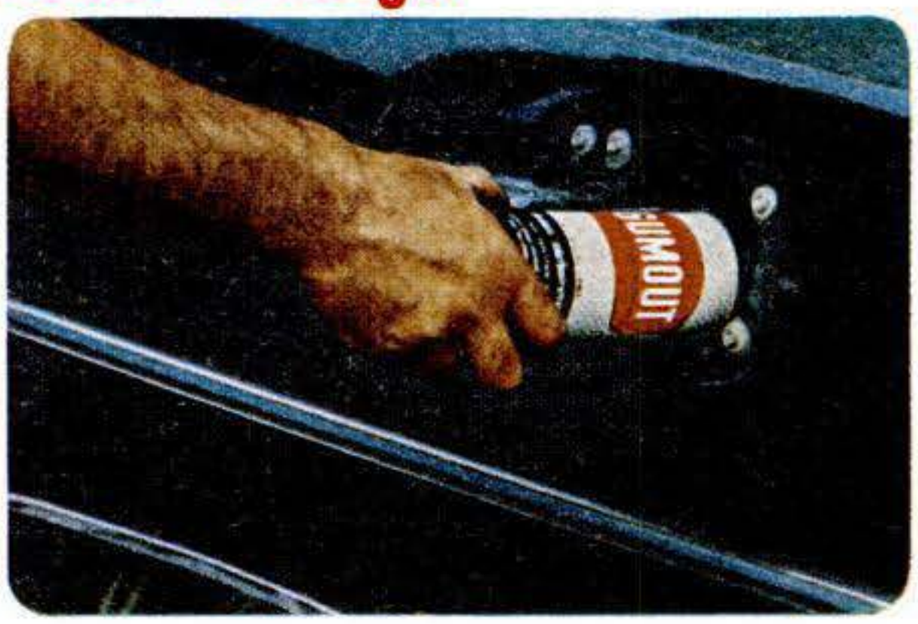
The clean team

Take a typically dirty carburetor (like yours maybe) clean it...and get easier starting, smoother idling, no stalling, faster take-offs and better mileage.



1 **Clean it outside in seconds with Jet-Spray Gumout.** Takes less than a minute to get **this!** Throat, choke valve, linkage, throttle plate—all clean like new. Grime and gum that can foul up the carburetor's job are gone. Completely.

2 Now pour a pint of Gumout in your gas tank. **It does the same great job inside your carburetor as you drive.** Cleans out all the jets and passages, removes the gum and varnish.

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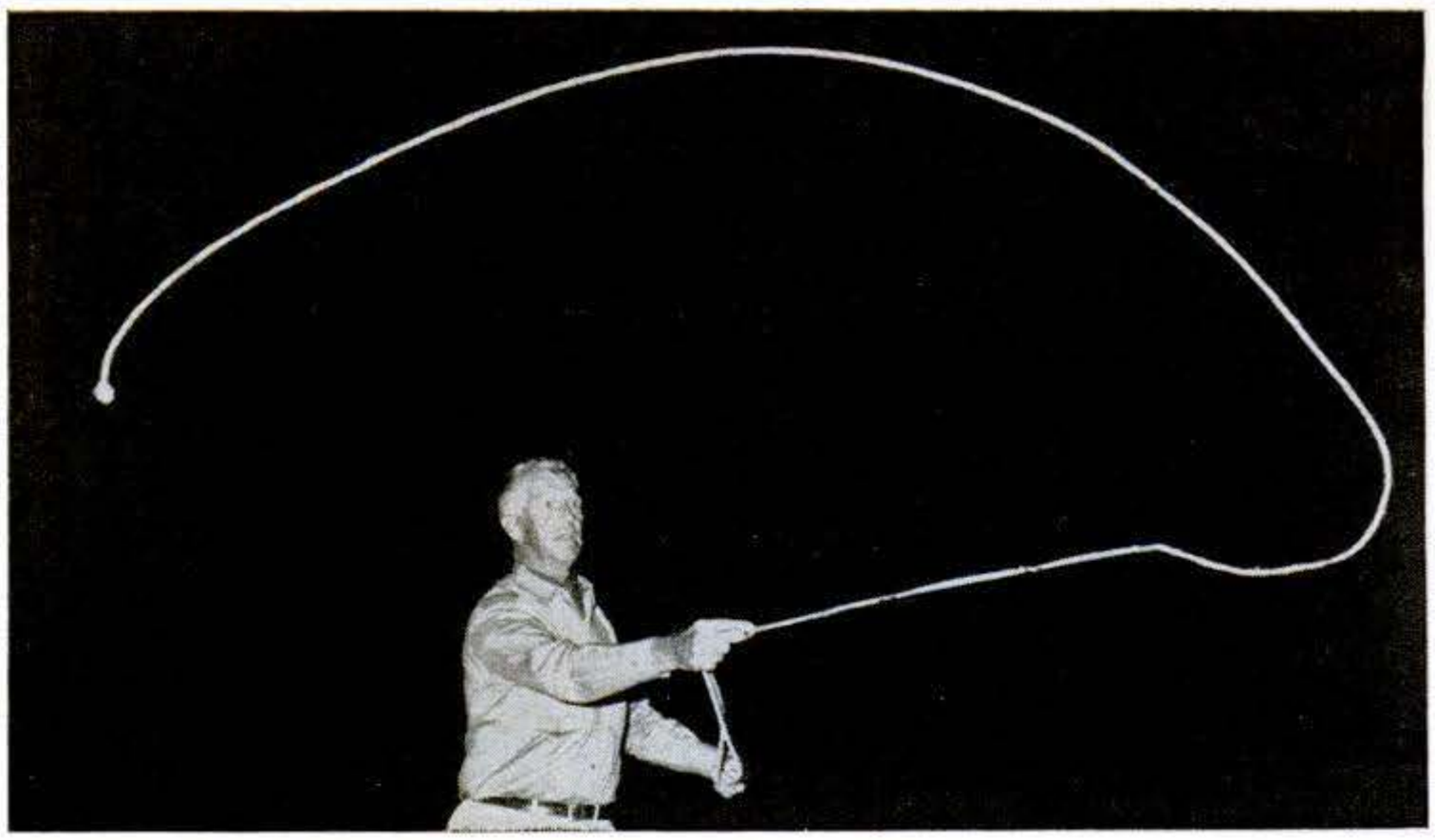
Recreation Roundup

. . . on the move with PS

By HERBERT SHULDINER



Teach-yourself flycasting kit gives expert's instruction

Famed fishing expert Lee Wulff has developed an easy-to-use kit with which you can learn—or practice—flycasting indoors or out. You get a three-foot fiberglass rod and 30 feet of level fly line and leader. A manual gives basic steps through roll casting, side casting, single and double hauling. The Fly-O is $6.95 from the Garcia Corp., 329 Alfred Ave., Teaneck, N.J. 07666.

Ford launches a camper club

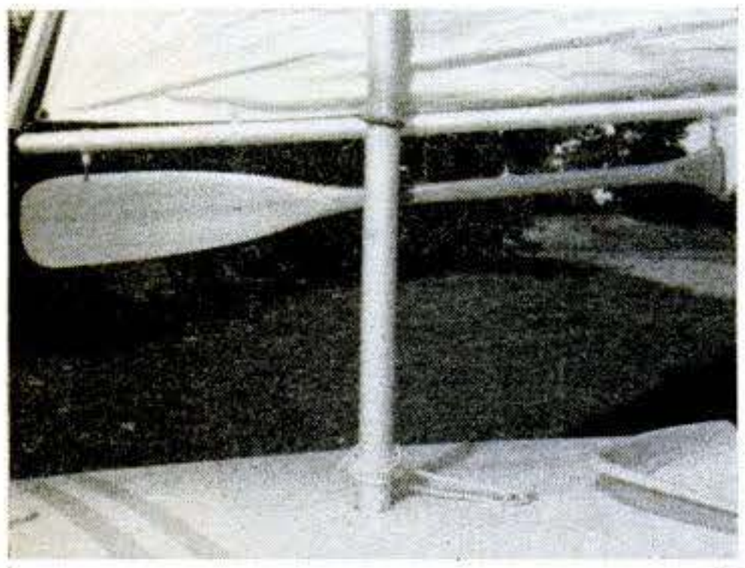
Spurred on by the fact that it sells more than 700,000 vehicles annually to consumers who use them for recreation to a great extent, Ford has founded an association to provide special services to RV owners. The Four Seasons Outdoor Association is open to anyone on payment of annual dues of $12.95.

That brings you a monthly publication with a 30-day weather forecast, provides a mail forwarding service and —on recreation trips—accident, death, and hospitalization insurance. You'll also get discounts on some camping equipment. For information, write to the Association at P.O. Box 1336, Southfield, Mich. 48075.

REACT helps outdoorsmen

Henry B. Kreer, national director of REACT (111 E. Wacker Dr., Chicago, Ill. 60601), tells PS that a number of snowmobile manufacturers are considering portable CB radios as a new option. That's because a large number of snowmobilers are showing increasing interest in two-way radio communication. Kreer also says that reliable estimates reveal that one out of five camping-vehicle owners are now using two-way CB radio to maintain communications on the highway, as well as for camping, hunting, fishing, and boating activities.

The do-it-yourself camper



Reader Walter W. Wayne passes along a tip for keeping a paddle handy on a small sailboat without having to stumble over it: Add an extra pair of sail clips to the mast end of the boom, free of the sail. Form a pair of hooks of brass wire, closing an eye at the top to button through the sail snaps. Put a brass screw eye in the handle of a four-foot paddle, drill a hole through the edge of the blade, and hang the paddle on the free-hanging hooks.

Watch that insurance, camper!

Is your trailer protected by your auto insurance if you hitch it to your car? Are you protected by your household insurance if somebody trips over one of your tent poles when you're off camping? Or suppose your dog bites a fellow camper, would you have to pay damages? Will your home fire insurance cover you if your campfire spreads and burns down trees around your campsite, or if you accidentally set fire to a cabin you've rented?

These are important questions many campers don't bother to get answered before they leave on a camping or vacation trip—much to their later regret. "Proper insurance can save you a great deal of money and expense while you are away from home and can assure you of having a carefree camping trip," says Stephen P. Janco of CNA Insurance.

Check these main points: The extent of your automobile insurance coverage when you hitch a trailer or camper to your car. Most liability policies cover damage caused by a trailer when it is being pulled by an insured car. But you need additional coverage to pay for any damage done to your trailer.

You should also carefully check the amount of insurance coverage you get when you rent a motor home or other camping vehicle. You might want more coverage than the rental agreement provides. And bear in mind that most rental-car companies prohibit hitching a trailer to their vehicles.

Before leaving your state: It's also a good idea to check your existing auto insurance before you make a trip to other states, Canada, or Mexico. If other states require proof of higher financial responsibility than your state does, you might be compelled to post a sizable cash bond should you be involved in an accident. This could possibly wipe out your savings, if the accident is serious.

Your insurance company can furnish you with a special yellow card which is accepted as proof of auto insurance coverage north of the border. This is more convenient than carrying your policy with you.

Your standard car insurance isn't good when you travel in Mexico. You can obtain special coverage for a Mexican trip from your own insurance company. There are also many companies located in border towns that specialize in selling this protection. Failure to have it could involve you in a very serious legal tangle if you have an accident somewhere down below the Rio Grande.

Your comprehensive personal-liability coverage would protect you against claims arising from someone tripping over your tent poles or being bitten by your dog. You can get this coverage separately or as part of your home-owners policy.

You might also want to consider special trip insurance to cover accidents or illness to your family while away on vacation. And it might also be a good idea to check on how much coverage your home-owner's policy gives you in the event that equipment is stolen from your camper or boat. You may want to buy a special floater policy to protect expensive guns, cameras, and camping equipment.

Things to write for

The how-to book of family camping tells you how to select a tent, set one up, what to look for in a sleeping bag, and even gives some tips on camp cooking. You can get a copy of this handy booklet from the Hirsh-Weis Division of White Stag, 5203 S.E. Johnson Creek Blvd., Portland, Ore. 97206.

The Sears 1971 *Fishing and Boating Equipment Catalog* contains a big assortment of new gear for your boat and water sport activities. You can hook a free copy by writing Sears, Roebuck and Co., Dept. 139, 925 S. Homan Ave., Chicago, Ill. 60607.

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Old Crow begins with men who love to work with their hands.

Some of Old Crow's men have been making whiskey so long they can almost find a flaw with their eyes shut. Eyes open, and hydrometer in hand, Ralph Wise analyzes each batch of our country Bourbon, making sure it tastes as good as it can be made.

Back in 1835, Dr. James Crow discovered that scientific controls could produce a Bourbon which tasted good bottle after bottle. Later, he handmade the first sour mash Bourbon. We still use our hands in making Old Crow.

"I get peace of mind working with my hands," says Wise, "and some pretty nice furniture, too."

Ralph Wise calls on the same craftsmanship making our Bourbon as he does refinishing this antique table. For a set of refinishing plans, write: Old Crow, Box 531, Frankfort, Ky. 40601.

Soften table's old finish with remover. Scrape. Use toothbrush to get at crevices.

Wipe wood with fine steel wool soaked in paint remover to avoid scratching. Sand.

Stain. The trick is to follow the grain, use long strokes, work fast.

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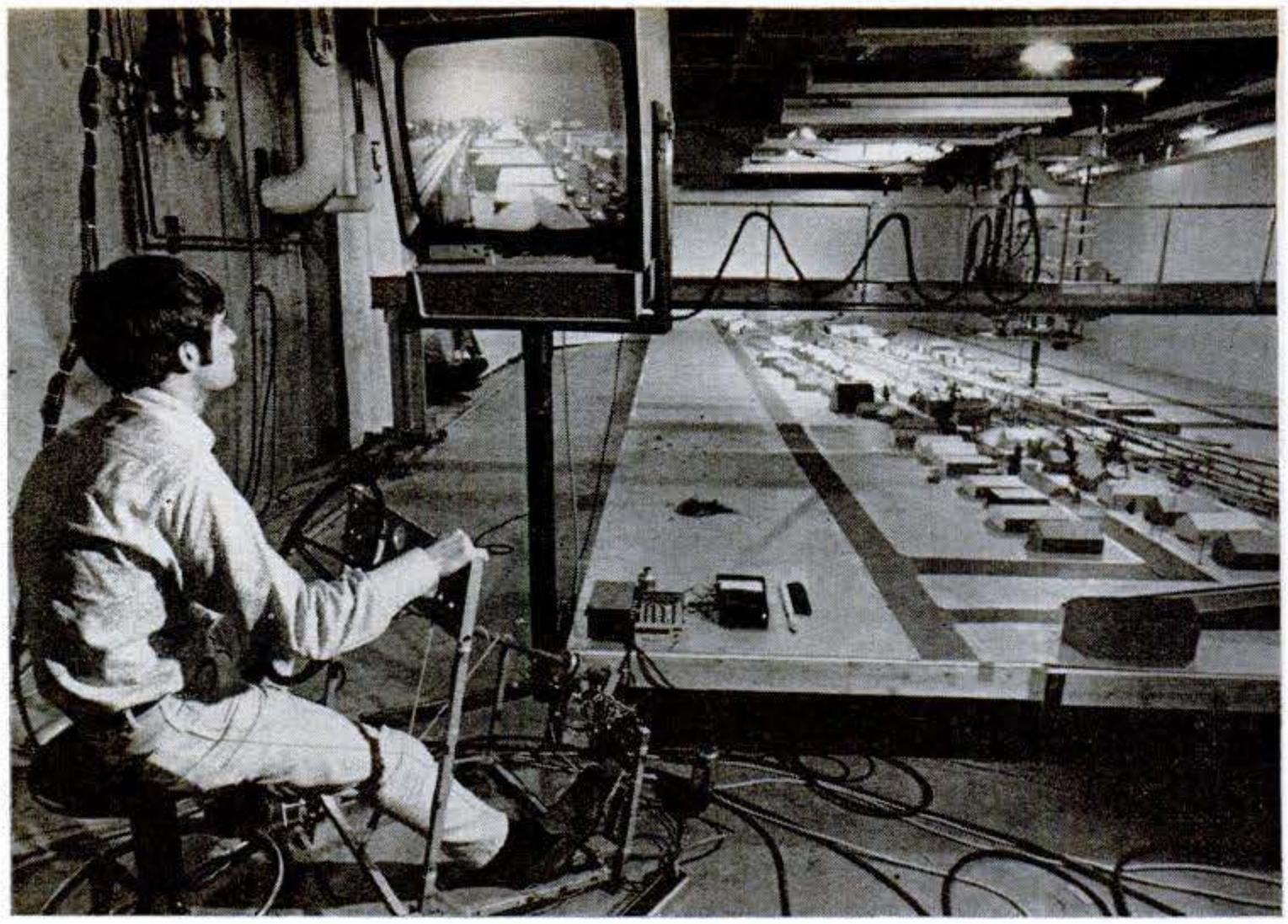
Science Newsfront

Last-minute news and notes to keep you up-to-date

By ARTHUR FISHER



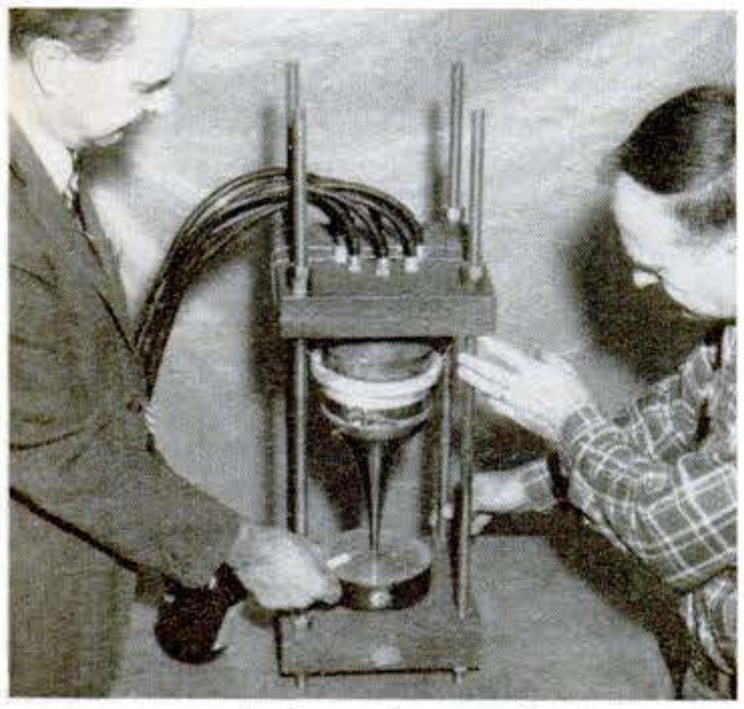
"Flying" TV simulates ride down automated roadway

Hunter Woodward, a student at the University of California, steers a TV camera mounted on a "flying" gantry crane over his model of an urban scene featuring Ford's proposed auto guideway. TV simulation gives the feel of a ride down the electrified road, which would allow cars to turn off gas engines and move safely at high speed.

Brighter prospects for X-rays

A new phosphor material—three to four times as effective as previous ones in converting X rays into visible light—promises high-quality medical and industrial X-rays with lower radiation dosages. Developed by Lockheed's Palo Alto Research Lab, the new phosphor—composed of the rare earths lanthanum, gadolinium, and terbium—will be used in X-ray image-intensifier tubes.

Magnetic hammer makes diamonds



A new technique for synthesizing industrial-grade diamonds has been developed by two engineers at NASA's Marshall Space Flight Center. J. R. Rasquin (left) and Morris Whittington use the apparatus shown to make clear and yellow diamonds—in small quantities—from graphite. The device was invented nine years ago at Marshall to hammer out distortions in misshaped rocket-tank sections. A magnetic hammer acts through a copper plate that rests on the large end of a steel exponential horn. The small end sits in an anvil pocket filled with graphite. A 5,000-volt discharge generates a shock wave that, amplified by the horn, subjects the graphite to enough heat and pressure to convert about one percent into diamond grit. The process is claimed to be much less complicated—and expensive—than other known diamond-synthesizing techniques.

First results of air-sea study

Bomex, the Barbados Oceanographic and Meterological Experiment, was one of the most formidable scientific investigations ever mounted—more like an amphibian invasion than an experiment [PS, Aug. '69]. From May through July 1969, bevies of ships and aircraft, satellites, buoys, and dozens of complex instruments sampled vital data from a huge cube of tropical sea and air. Now the first phase of data analysis is complete, and the first results of Bomex are in—with some surprises. Measurements of visible radiation reflected by the ocean, for example, show that it returns about three percent of incident radiation, half the previously assumed value. This means the Earth is dimmer than scientists had heretofore believed.

Galactic surprise

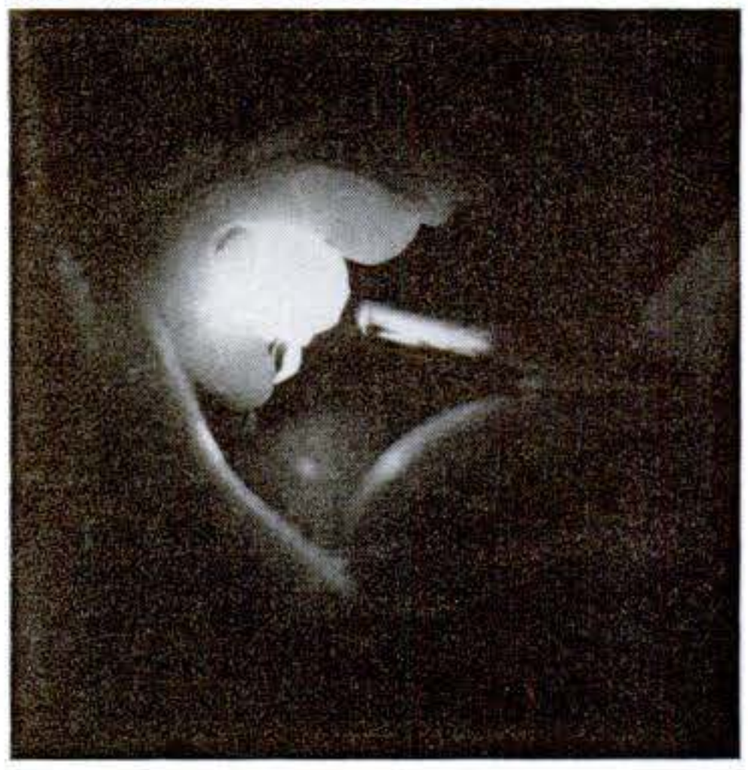
Astronomers can see billions of galaxies in the observable universe, and new ones are being discovered constantly, usually at vast distances. But California astronomers have now spotted what seem to be two large galaxies practically in our own back yard—a mere three million light-years away! They're in the local cluster of galaxies that includes the Milky Way (which contains our own solar system) and Andromeda. The surprising neighbors escaped detection until now because we must view them through an opaque veil of interstellar "dirt" in the Milky Way.

Rainmakers score success

After five years of theorizing and experimenting with cloud-seeding techniques, a team of scientists at the National Oceanographic and Atmospheric Administration has carried out what is probably the most successful rainmaking venture to date. Drs. Joanne Simpson and William L. Woodley increased rainfall from individual cumulus clouds as much as sevenfold over normal by seeding them with silver-iodide crystals via flares dropped through the cloud.

In the experiment—conducted over southern Florida between April and July of 1970—the NOAA scientists seeded 13 clouds and compared their rainfall with 16 unseeded clouds used as controls. They are now working on a technique to promote cloud mergers by seeding.

New light on tooth decay



Transillumination, the venerable technique of shining light through teeth to spot tooth decay and diagnose other problems, has been given a considerable assist by fiber optics. A new device called the Intra-Oral Illuminator, developed by American Optical, can deliver up to 1,500 footcandles of light using six-foot bundles of flexible fiber optics.

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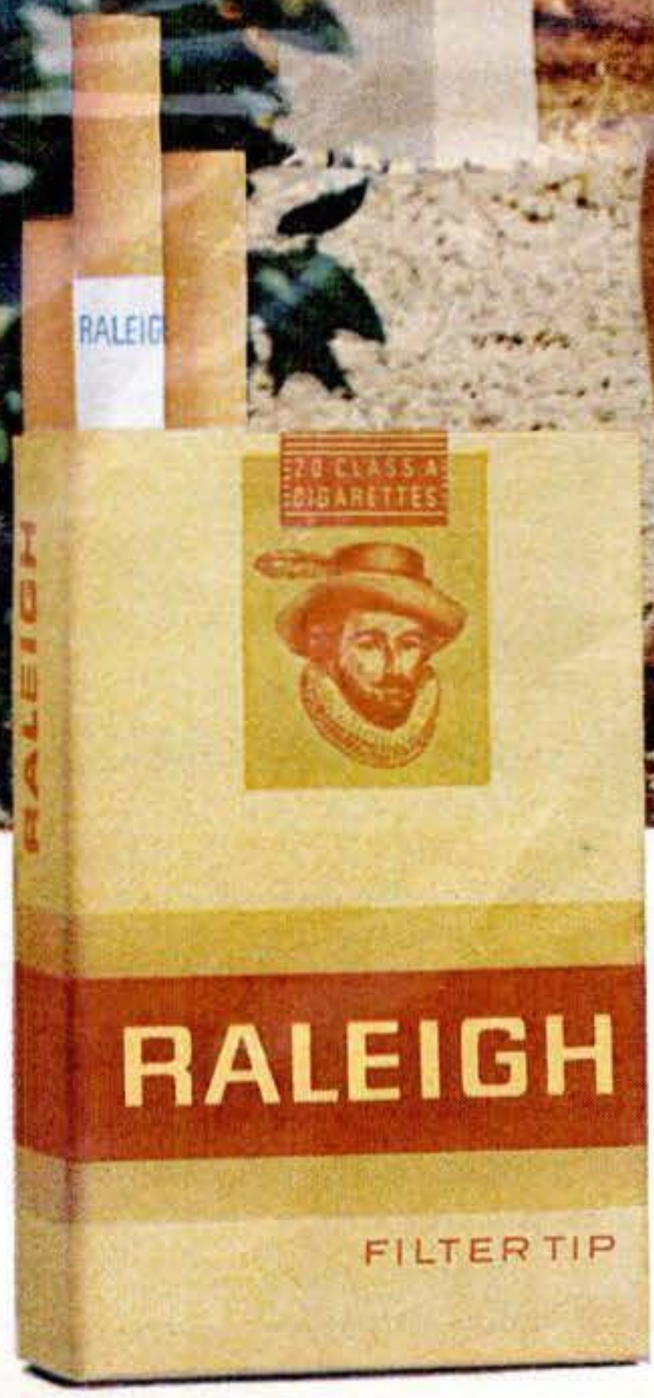

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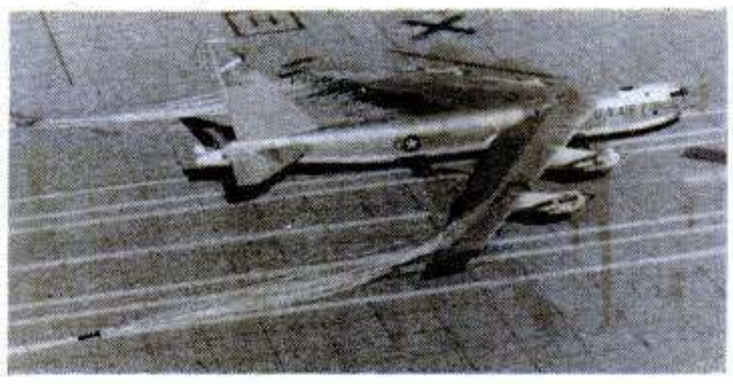
Science Newsfront

[*Continued*]

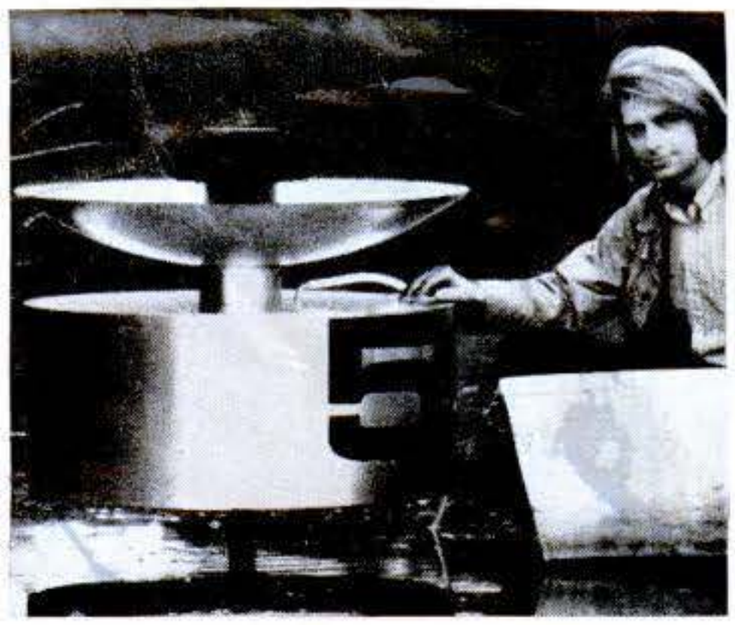
Heat inside the patient's mouth, a disadvantage of other types of transilluminators, is avoided because the light source is remote from the instrument's head. Transillumination is a useful adjunct to X-ray diagnosis and may even supplant it in mass screening and in children's dentistry.

Stop that plane!



This U.S. Air Force B-52 bomber, weighing more than 15 tons, has been safely stopped by a web of nylon strands in a simulated overrun of the runway on landing at Edwards Air Force Base. Such accidents have taken more than 225 lives in the last 10 years as a result of failed brakes, icy runways, pilot error, and other causes. The system shown—developed for the giant aircraft of this and the next decade—is an outgrowth of similar systems for smaller craft. It consists of nylon barrier nets linked to "water twisters"—rotary hydraulic brakes that convert a plane's kinetic energy into heat by spinning a paddle-wheel rotor in a liquid-filled steel tub as the motion of the plane unreels nylon tape attached to the nets and wound around the rotor. Variations on this system, which is being tested under license to All American Engineering Co., have been installed at military airfields all over the world, and at airports in England and France to protect the Concorde SST.

Automatic aerator



Craig Vetter demonstrates his ingenious invention, an aluminum still-water aerator that needs no energy source. A gas enclosed within a small cylinder expands and contracts with changes in air temperature, driving a slave piston. The piston forces water into a large cylinder, aerating it, and then expels it into the sluggish stream or pond the aerator is mounted in. Designed to provide temporary relief for bodies of water threatened with destruction for lack of oxygen, the device won Mr. Vetter a $2,000 prize in Alcoa's Ventures in Design program.

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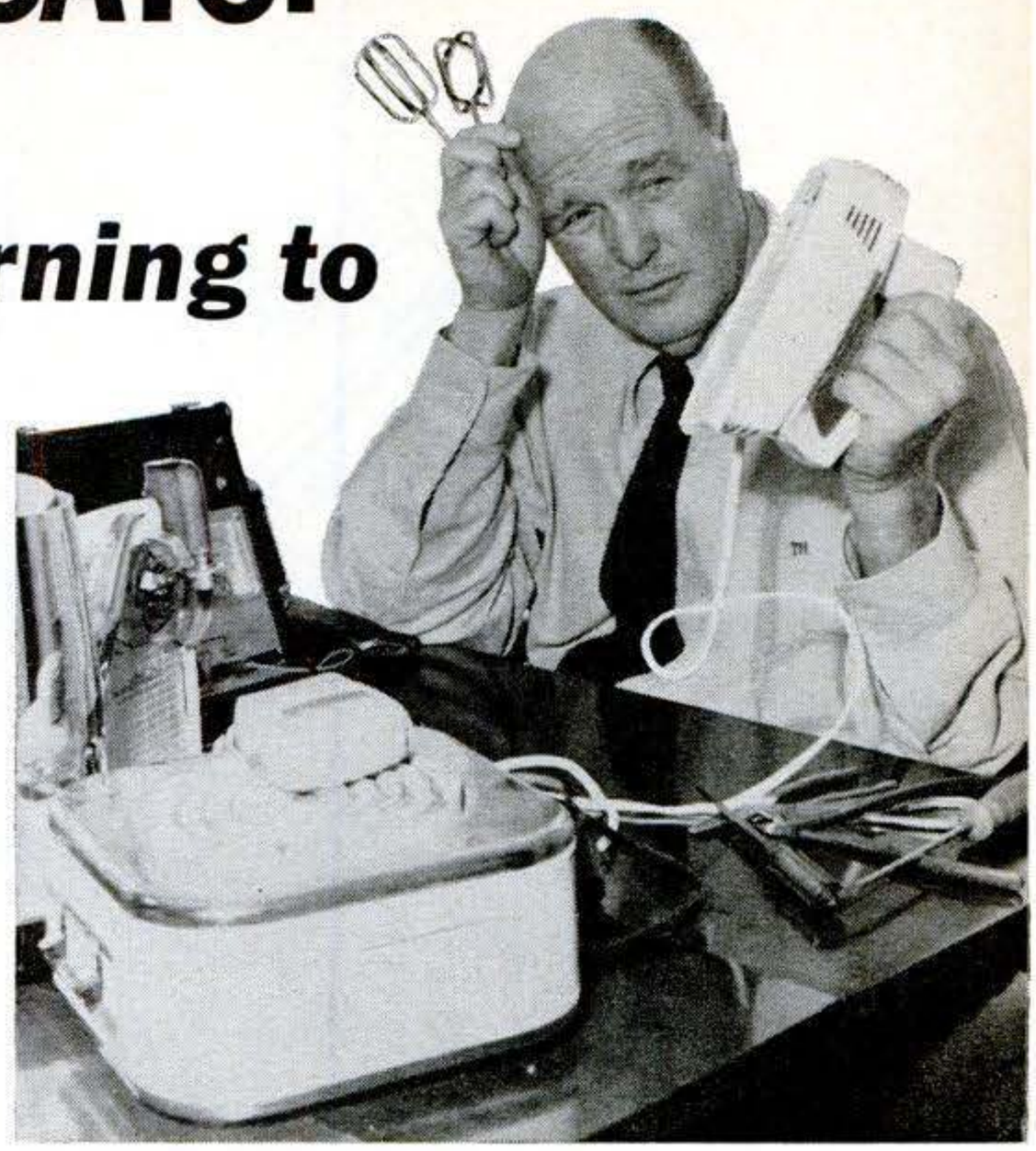
TOM McCAHILL SAYS:

"A great toehold on success is learning to fix these things."



If you're wondering how to fatten a skinny bank account, I recommend a great way to work your way out of the Badlands. As any homeowner will tell you, a washing machine that won't wash or a refrigerator that won't refrige is just as frustrating as meeting your mother-in-law in a strip joint. What's worse, when it comes to hunting up a guy with the know-how to put things right, chances are you'll cool your heels for hours—even days—because good appliance repairmen in your neck of the woods have more business than they can handle.

With a couple of dozen appliances in every man's castle, there just aren't enough well-trained repairmen to take care of the demand. These days, with everyone from Uncle Sam to cousin Julius putting the touch on you for financial help, people aren't about to throw out a bum washing machine or even a twenty-dollar toaster if it can be fixed for a few bucks. Yet, today's complicated appliances call for special know-how the average Joe can't acquire without training.

Fortunately, there is a quick and easy way for any ambitious man to get the training he needs and start raking in $5 to $7 an hour in his spare time; or even save more than that repairing his own appliances. It's a great, low-cost home-study plan offered by the Appliance Division of National Radio Institute, one of the biggest, oldest and best-known schools in the field of home education.

The course shows you all about repairing a crater full of home appliances (including air conditioning and refrigeration equipment), as well as commercial appliances, small gas engines, power tools, even special appliances used on farms. The cost of training is amazingly low. Two spare time automatic washer repair jobs could just about pay the total tuition.

And the way NRI trains you, you don't need the memory of an elephant to handle the different kinds of jobs you'll be faced with as a repairman. You don't even need to know the first thing about electricity or appliances when you begin your training. NRI's learn-at-home methods and the constant, expert, personal help of its large staff make this one of the easiest and most rewarding fields a guy can enter.

If you think you'd like to find out more about a field that's hotter than the insides of a thirsty camel, all it takes is a postage stamp. Fill out the coupon below and NRI will send you its free Appliance Repair catalog. Read about the training that can give you a sure toehold on success, through spare time earnings or a full-time business of your own, or even save you the cost of the course by showing you how to repair your own appliances. No salesman is going to bother you. NRI doesn't employ them. There is no obligation—except to yourself.

Tom McCahill

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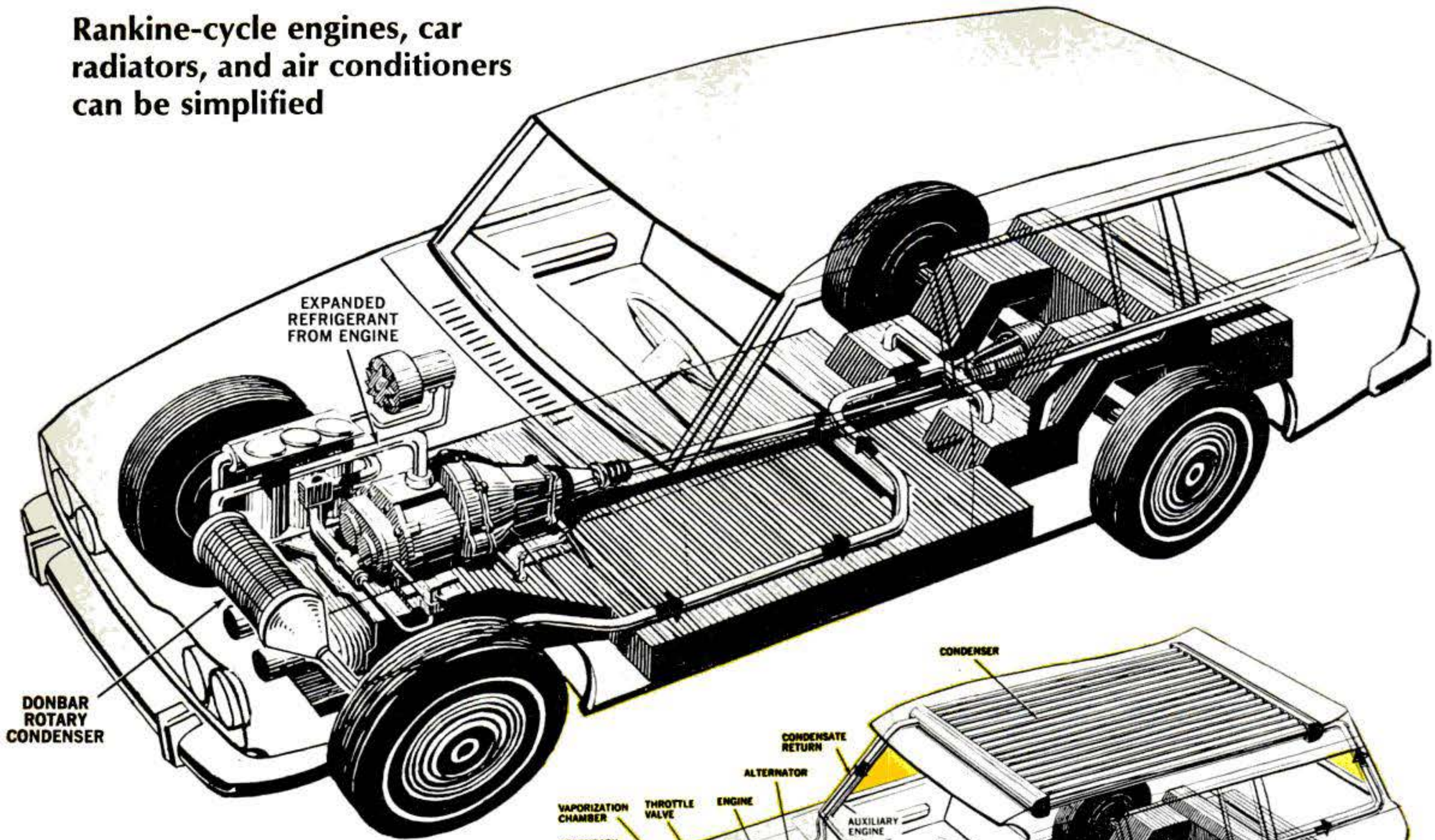
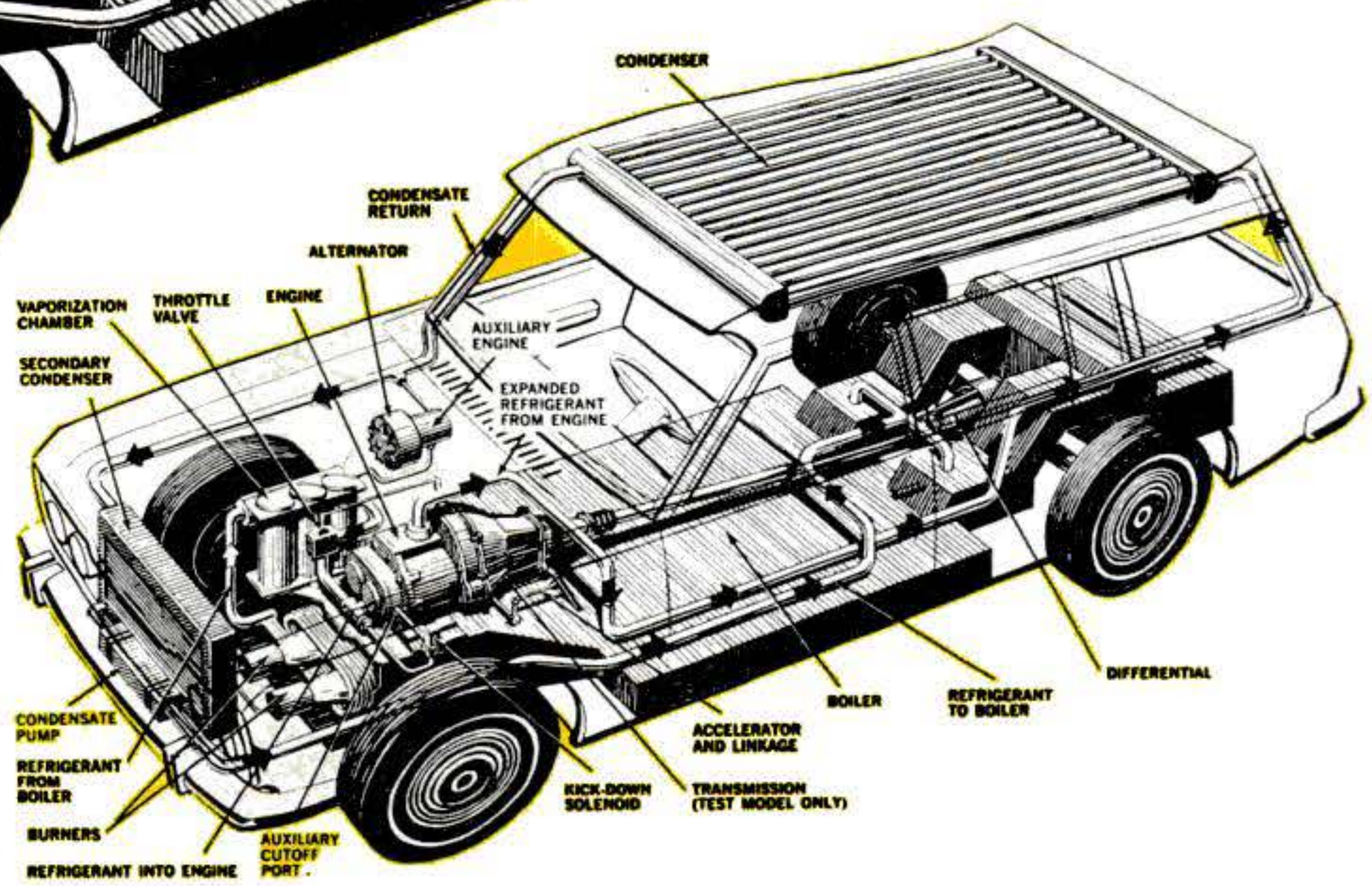
Rankine-cycle engines, car radiators, and air conditioners can be simplified





Steamless "steam" car by Minto could substitute a single, high-capacity rotary cooler (above) for cumbersome condensers (right).

New Rotary Heat Exchanger: It Doubles Cooling Efficiency

By E. F. LINDSLEY
PS Midwest Editor

A new concept in heat exchangers —so simple you'll say "Why didn't I think of that?"—now promises to make the steam car or the fluorocarbon car practical; do away with your car's fan and radiator; take the noise out of home air conditioners and make them lighter and smaller; and maybe lift the thermal-pollution curse from nuclear-power plants. All of this will be possible at lower cost and with uninvolved hardware.

Called a rotary heat exchanger, this device takes the familiar blades of a squirrel-cage blower, makes them hollow so that hot (or cold) liquid or gas can flow through them, and spins the blades to bring the heat-transfer surfaces into contact with the air.

Rudimentary? Not to engineers at Purdue University and those in the German Labs of New York-based Donbar Development Corp., who have devoted over eight years to computer studies for the right design.

Heat exchangers are so vital to everyday devices that we often forget about them. In your car, or in a power-generating plant, they must be used simply because our engineering talents now—and for the foreseeable future—turn only a token portion of the heat-energy input into useful work.

A good diesel engine, for example, uses about 30 percent of its fuel heat energy to turn the crankshaft; 70 percent is wasted. Your car is even worse. So a radiator (heat exchanger), with air forced through it by the fan and by the car's motion, disposes of some of that 70-percent-plus wasted energy. Exhaust gases and radiation carry away the rest.

Air conditioners, on the other hand, exchange heat from inside your home to a refrigerant that carries it to another heat exchanger to be dumped into the outside air.

They haven't changed much. Except for variations in manufacturing techniques, heat exchangers have been about the same for 40 years. The basic idea was sound. You passed the liquid or gas through a bundle of tubes fitted with closely spaced fins. The fins increased the surface area available for heat exchange.

But just letting the tube-bundle radiator stand in dead air isn't very effective. What engineers call the heater-transfer coefficient (Btu per hour per square foot per degree F)

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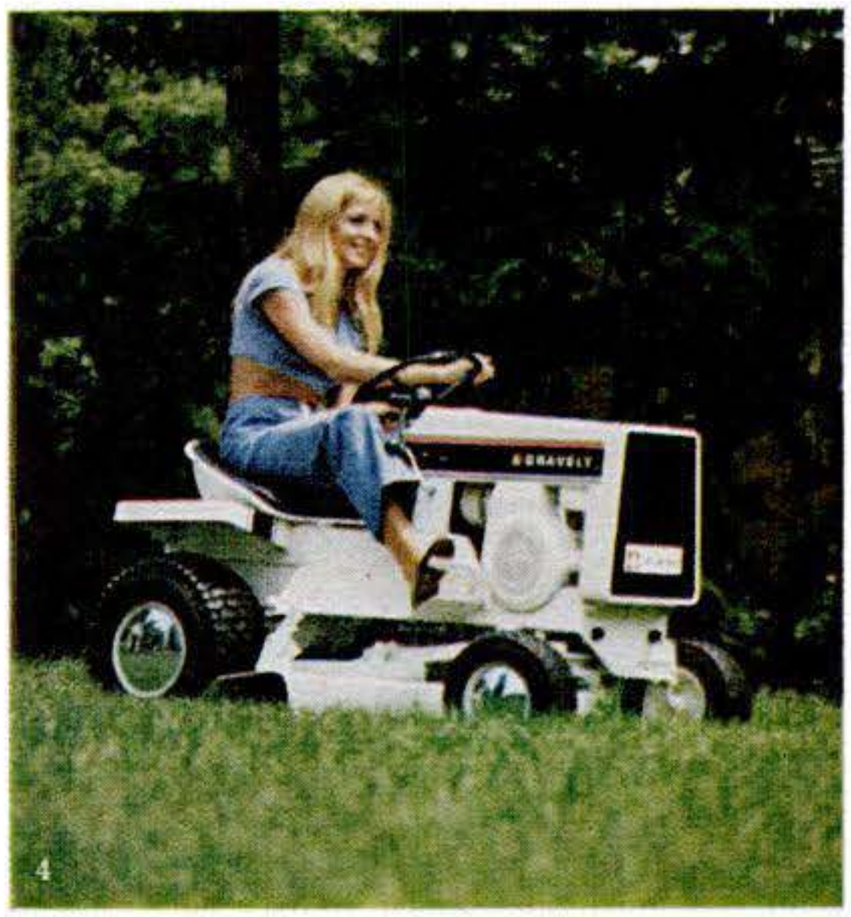

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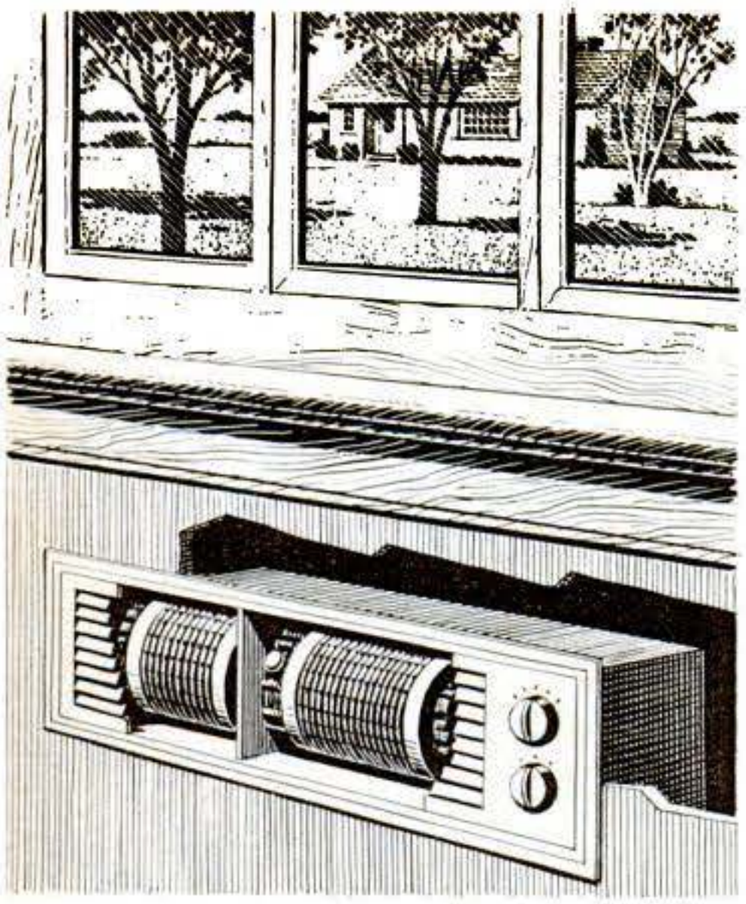
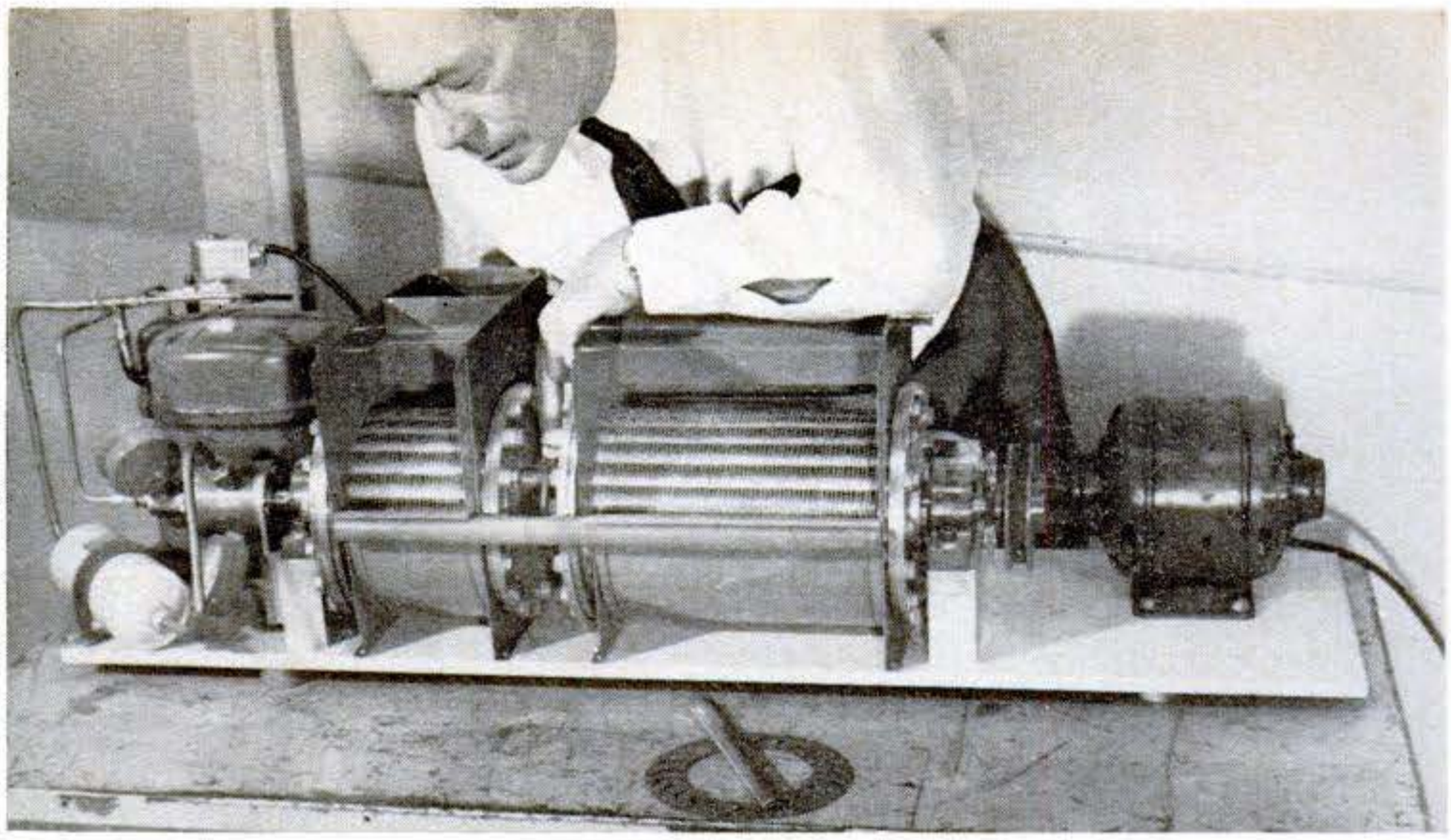
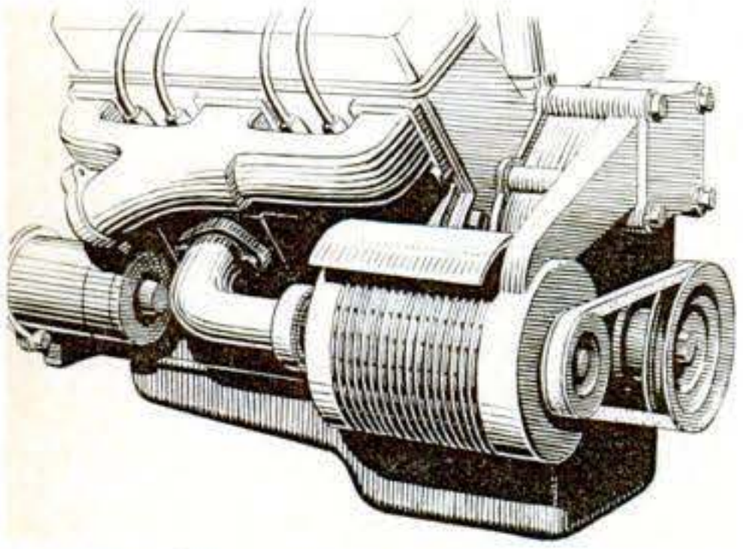


Heat pump could cool or heat room by reversing flow of refrigerant or reversing exhaust grids. Exchangers double as blowers.

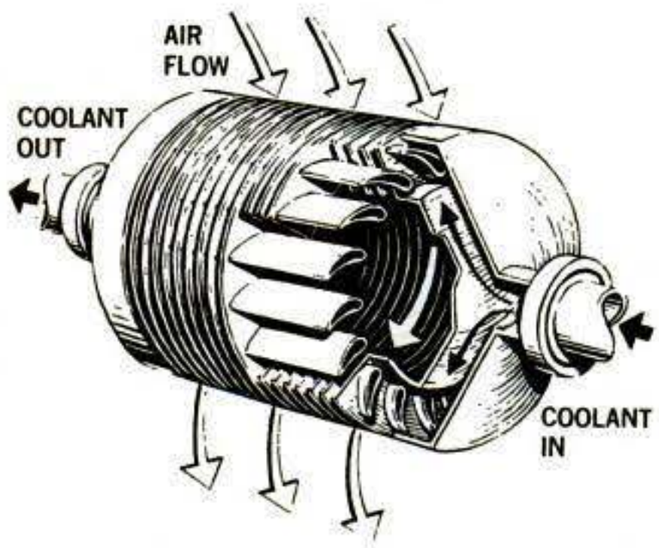


Air conditioner uses two rotary exchangers. Single shaft with internal passages to and from compressor conducts hot refrigerant to condenser on the right and back through an expansion valve (examined by Lindsley) to evaporator, left. This is a lab model.



Rotary radiator could replace cooling system for internal-combustion engines. A water pump would be built into exchanger.

How the exchanger works



Key to the spectacular cooling performance of the rotary heat exchanger is the complex air turbulence generated by the tangential (squirrel-cage) blower. In addition, its hollow blades bring the heat-exchange surfaces to the air, rather than forcing air over the surfaces as conventional cooling units do. Each airfoil-shaped blade churns up a pattern of turbulence that is "seen" by the next blade. An air particle passes over a blade once, moves through the hollow center of the rotary exchanger, then passes over the blade again on the way out. Bare blades are the most efficient, but, paradoxically, fitting fins to the blades adds to the total heat volume removed.

shapes up to a measly figure of two. Forcing air over a simple tube with a fan raises the figure to six. A good air-conditioning tube-and-fin bundle may have a coefficient of eight to 10. Car radiators, where more fan noise and air turbulence can be tolerated, typically have coefficients in the 18 to 25 range.

Donbar's studies have shown that a rotary heat exchanger can boost the coefficient figure for air conditioners up to 24. The figure for car radiators using a rotary exchanger could be from about 45 to 51.

Much of the problem has been bringing the air to the heat-exchange surface. The usual fan-and-radiator combination has always been handicapped by a number of factors:

- Noise becomes intolerable at air velocities needed for high efficiency.
- Efficiency is reduced because fans require clearance space, and perfect flow over the entire surface is almost impossible.
- Power in performance-robbing amounts is needed to drive the fan.
- Placement of radiators in the airstream, necessary to help the fan, imposes a design limitation.

Cure for pollution? Today, new demands for engines and power plants without a massive pollution penalty are forcing hard second looks at power sources. Both steam and fluorocarbon (Rankine-cycle) engines ["Minto's Steamless 'Steam' Car," PS Oct. '70] have been intensively researched.

A General Motors paper describes a steam condenser 42 inches wide and 19 inches high. Getting rid of the required one million Btu per hour took two fans turning at 3,000 rpm. The 22 hp taken by the fans drained the zip out of the 100-hp engine.

Lear, working with steam, was faced with a condenser 55 by 38 inches, again with two 3,000-rpm fans. Minto, committed to actual production of a fluorocarbon car for Datsun, has been contemplating two condensers, one the size of a large radiator at the front of the car, and another occupying the entire roof panel.

Ford ran into the same thing. Their Thermo Electron thiophene project created a need to chase $1\frac{1}{4}$ million Btu per hour out of the condenser. Donbar says Ford has recognized the possibilities of the rotary exchanger. Present thinking calls for a rotor 15 inches in diameter and 16 inches long for the Ford car. The power needed to drive such a condenser is only seven to eight hp. Minto is interested, too.

Given that the Rankine-cycle cars —steam, fluorocarbon, or whatever— may be some time in coming, what can rotary heat exchange do for the present internal-combustion car? According to Dr. George N. Faris, president of Donbar, it could:

- Let car makers throw away the fan and radiator.
- Permit mounting the heat exchanger anywhere on the car.
- Do away with overheating when a car is stalled in traffic.
- Reduce cooling-system costs significantly.

What he's saying is that the cooling water could be passed through the whirling blades of the rotary exchanger and the exchanger could be placed wherever convenient regardless of styling or air flow relative to the car. Noise would be lower and less power would be wasted than with the present fan.

Dr. Faris goes one step further. He

[*Continued on page 118*]

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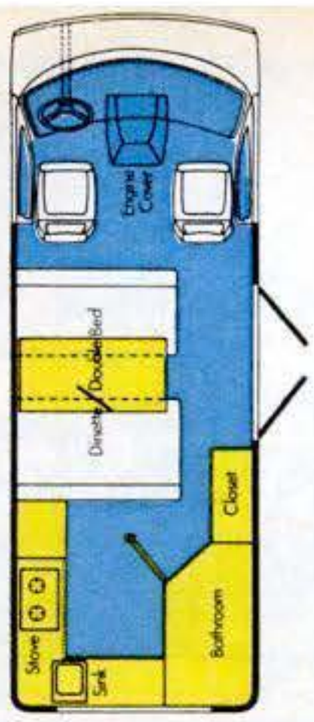

*Family Wagon Royale 1800 conversion by Travco.

Sized and priced in between the midgets and the mammoths.

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New Dodge Sportsman Maxiwagon – world's biggest compact truck. Breaker of the barrier between the midgets that don't fit your family and the mammoths that give your budget a fit. The Maxiwagon provides more interior room than any other compact wagon—almost 13 feet from engine cover to rear windows. This has led to many ingenious ways of putting the comforts of home on wheels for less than the average price of the mammoths. We provide a lot of comfort for a family of five—with more leg- and knee-room and more counter top and storage space than the midgets', a home-sized dinette, optional lavatory-shower, even a full-sized, overhead pullout bunk, also optional. Dodge gives you more features, too. Full-foam-padded seats; conveniently located pedals, seat, steering wheel, and car-type dashboard to insure driver comfort; and a 127″ wheelbase for superior ride and stability—all standard. Options for the Maxiwagon include power brakes, integral power steering, automatic transmission, integral Fresh Air air conditioning, automatic cruise control, and AM/FM stereo radio. And no other compact wagon can give you that combination. If you're thinking of buying a wagon, any kind of wagon, be sure to see the Sportsman Maxiwagon at your nearby Dodge Dealer's. Ask him about all the camper conversions available for it. Here you see one of them.*

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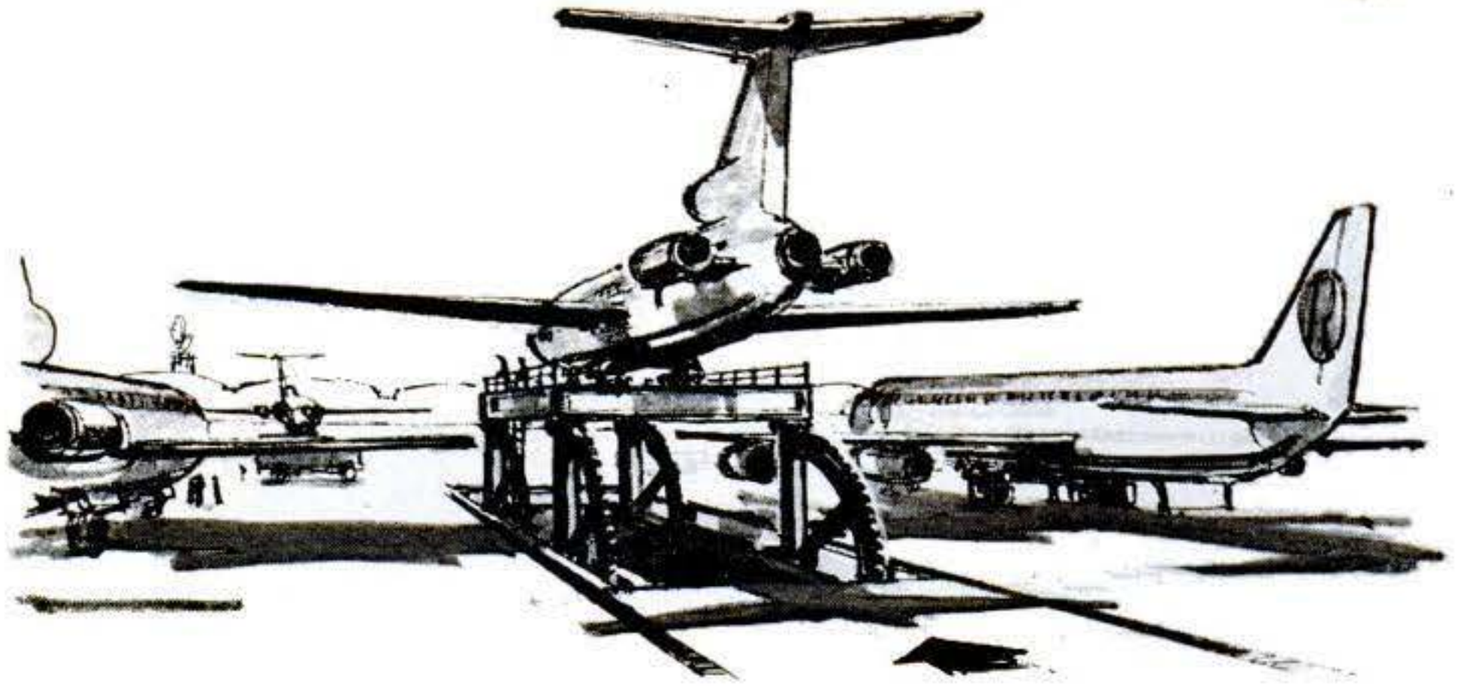
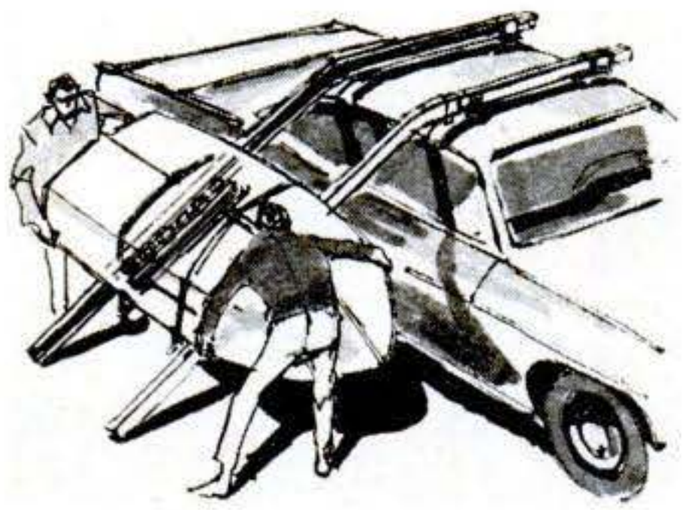
New Ideas from the Inventors

ILLUSTRATIONS BY DANA RASMUSSEN



Lifts increase airport parking. Power-lifted platforms on the parking aprons of a crowded airport might permit space-pinched facilities to handle more and larger aircraft. The mechanism of this recent patent would raise a plane parked between and behind two others, then move it forward so the wings would overlap, yet leave clearance for service and maintenance in less ground space.

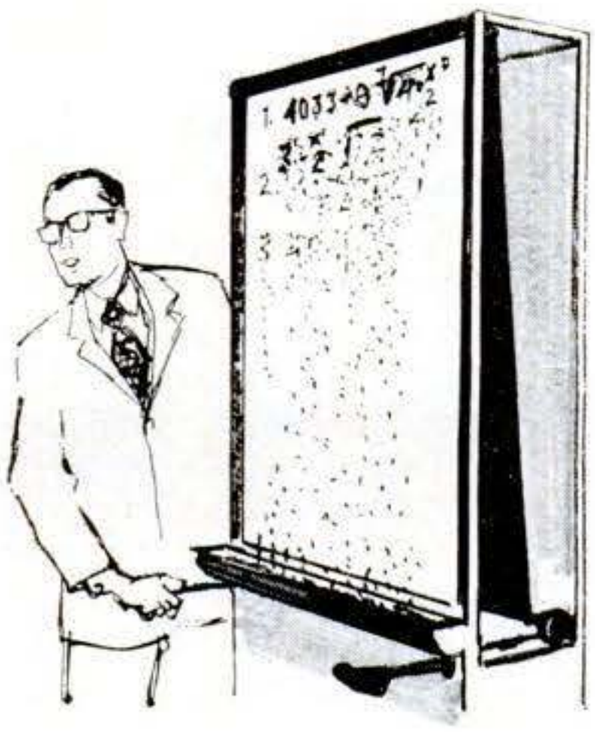
Camper step folds itself. Attached below the door of a camper (or of a truck or wagon), this spring-loaded step would open down under your weight, retract when you stepped off. More convenient than a portable step, and loss-proof, it would not affect a vehicle's clearance or mobility.



Slide rack lifts boat. Guided in extension car-top tracks, a dolly would reach down to ground level, where you could attach a boat or other load with straps. The slides—and load—could then be rolled up the track to stowage position and secured. The tracks would also lighten the job of unloading a boat.

Bumper clip raises flare. Ready for instant use in any road emergency, flare would be encased in a protective jacket. When pulled out and ignited, it would snap upright at a safe distance on the end of a spring arm for maximum visibility. Retracted, it would double as a decorative bumper attachment.

Walking stick cases rod. A disassembled fishing rod could be an aid to an outdoorsman instead of a hindrance if he carried it in a case like this. Pointed at one end and with a hand grip at the other, the rigid rod protector would become a sturdy walking stick. Unscrewed, the pointed end of the case would make a ground stake for the rod.



Magnet erases chalkboard. With "chalk" made of iron particles pressed into the barrel of a pencil, a lecturer could illustrate his subject on a plastic facing sheet of any color. To erase the board, he'd merely pull the top-hinged facing away from its magnetic backing. The ferrous particles would drop into a trough for collection and reuse.

The following ***patents have been issued on these inventions:*** **Plane parker**—*No. 3,489,297* ***to W. McLain and G. Jenkins, Tampa, Fla.;*** **Camper step**—*No. 3,517,942* ***to M. Cuffe and R. Frese, Palo Alto, Calif.;*** **Boat loader**—*No. 3,452,893* ***to K. Heflin, Columbia City, Ind.;*** **Bumper flare**—*No. 3,520,273 to T. Daifotes,* ***Tuolumne, Calif.;*** **Rod holder**—*No. 3,515,263 to J. Carlson, Fresno, Calif.;* **Magnetic blackboard**—*No. 3,509,644 to M. Santell, Hales Corners; R. Powers, Milwaukee; and S. Claus, S. Milwaukee, Wis.*

Copies of patents may be ordered, by number, *from the Commissioner of* ***Patents, Washington, D.C. 20231, at 50 cents*** *each. To write to an inventor,* ***address him (by name and patent number)*** *in care of the Commissioner.*

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Taste too hot to handle?

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The outboard built like a racing car.

We didn't build our Johnson Sea-Horse 125 hp low and fast just so we could say it's low and fast.

Good engineering let us build it low. Like the V-4 design's short, straight-in fuel induction paths. Or the compact cooling and internally tuned exhaust systems. Or the short, rigid crankshaft. Or the Capacitor Discharge ignition system, which has fewer parts, yet is 20 times faster than conventional ignition systems.

Our Sea-Horse 125 is a full one-third shorter than competitive outboards. You can fish over it. See over it. Tow skiers over it. Can you do all that with anybody else's motor? Ask them. And while you're at it, see if their outboard has a low center of gravity for extra turning stability. Or if it takes up less space when tilted forward.

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Just tell him you want to see the little motor. With big go.

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Watch for two Johnson NBC-TV specials. March 14, "The Greatest Show on Water . . . at Cypress Gardens", with host Ed McMahon. April 11, "National Boating Test". Checks your knowledge of the basics of safe boating. And see the Greatest Show on Water at your Johnson dealer's during March-April.

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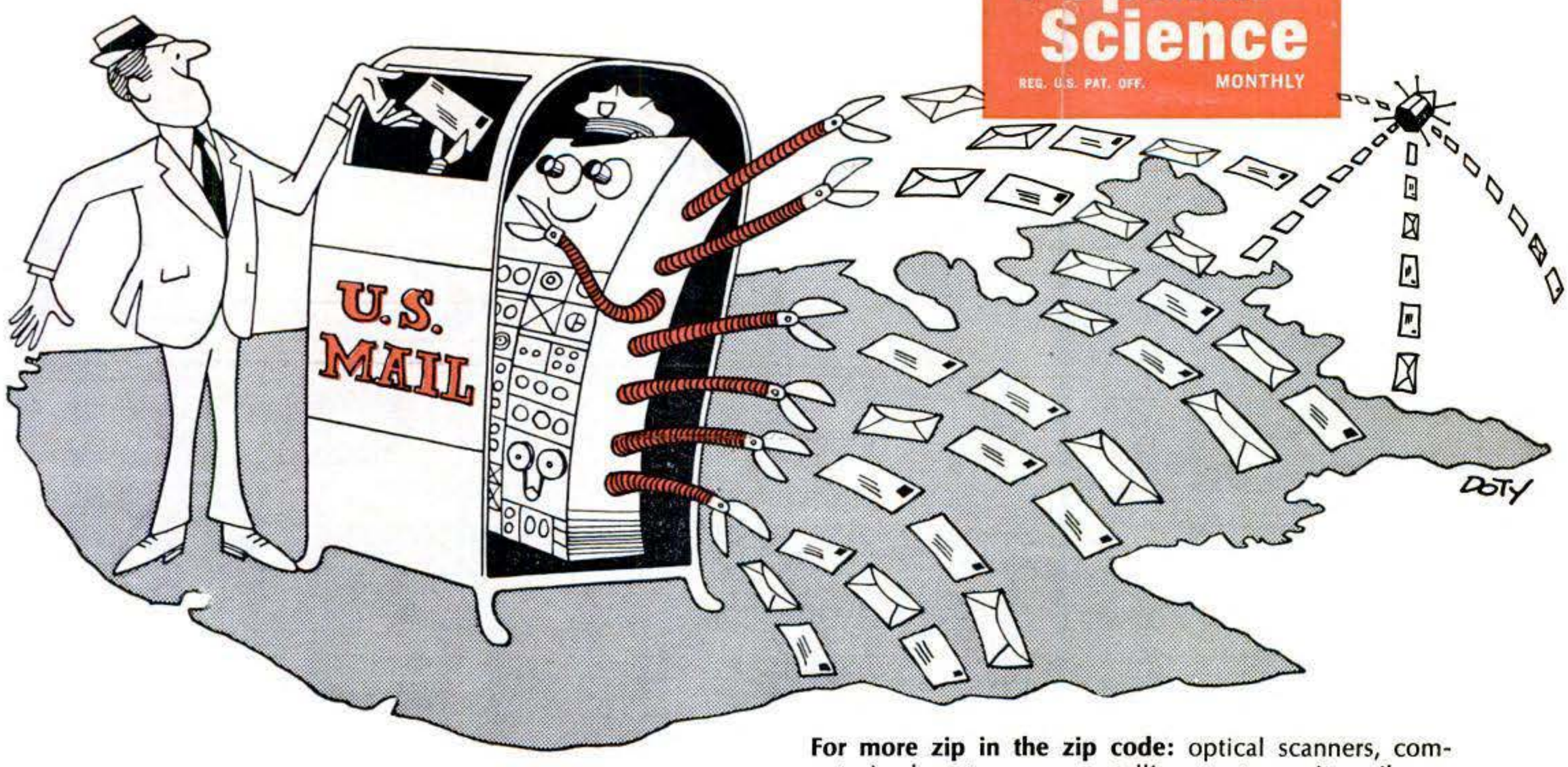

For more zip in the zip code: optical scanners, computerized sorters, even satellites to transmit mail.

How Science Will Speed Your Mail

Don't despair. The Postal Service has at last taken the giant step into the computer age with a clutch of ingenious devices to sort out the great mail mess

By EDWARD EDELSON
ILLUSTRATIONS BY ROY DOTY

When President Nixon signed the bill creating the United States Postal Service last August 12, he set the stage for one of the biggest salvage jobs in history—the effort to turn the moldering, barnacle-encrusted contraption that delivers the U.S. mail into a streamlined, reliable mechanism worthy of the 20th century.

At the moment, our post offices are about as modern as President McKinley's moustache cup. Aside from a few scattered bright spots, we've got a dreary mixture of slow, clanking machines and laborious, expensive hand labor moving mountains of mail with infinite weariness.

The dream of the new Postal Service is something else again—a technological wonderland where computers, optical scanners, and other electronic devices will help deliver the mail swiftly, cheaply, and with a minimum of human effort.

Glimmers of the future are here already—machines that automatically cancel stamps on 30,000 letters an hour; huge sorting machines that triple the output of the clerks who route letters toward their destinations; and electronic eyes that read and interpret more than 43,000 addresses an hour. On the horizon are fluidic devices to float letters along on cushions of air, and satellites to transmit letters coast to coast almost instantly.

More money—less red tape. In the job of getting from the lackluster present to the gleaming future, these will be the Postal Service's major contributions. When the Service comes into existence formally (no later than this August), it will be a semi-independent organization with authority to spend up to $7½ billion for new buildings and equipment over a five-year period. Unlike the present Post Office Department, the Postal Service won't have to get congressional approval of virtually every proposal for faster service.

That makes the modernization job sound relatively simple. But there's one big catch—the job must be done without interrupting mail flow. Some 84 billion pieces, from post cards to bulky parcels, came pouring into post offices this year. Next year that will increase by four billion. By 1980, we'll be mailing 120 billion pieces, and if that mail stops moving, all business stops, too.

So no new wonder machine can go in until the people in charge are sure that the mail will be delivered even if the machine breaks down—a requirement that makes postal modernization the equivalent of a heart-transplant operation on a stevedore who can't afford to miss a day's work.

Until 1950, the department spent *nothing* on research and development—an unheard-of situation for any other high-volume industry. When spending was authorized, it was hardly breathtaking; for fiscal 1950, a puny $98,000 was budgeted. By 1961, spending was a not-too-impressive

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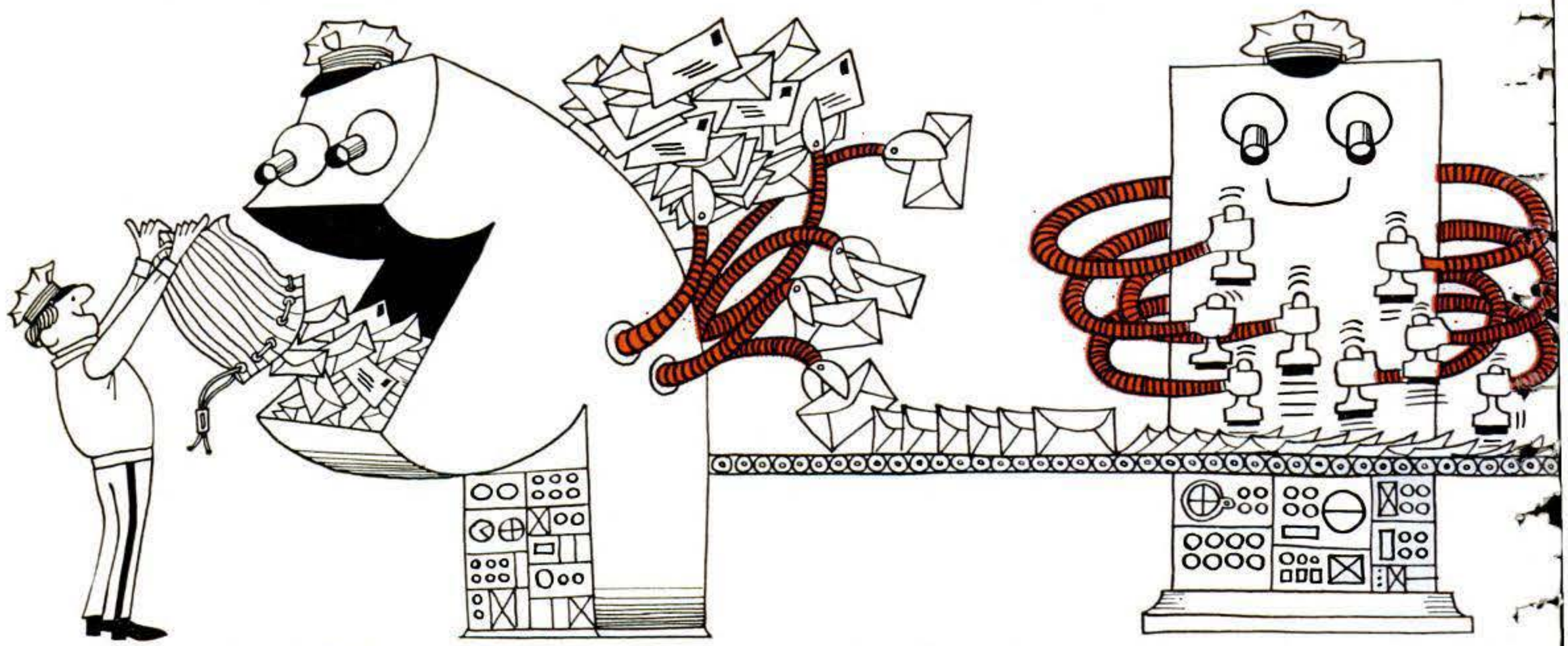
This experimental, computerized system is operating now in Cincinnati . . .



New system's input at central P.O. accepts all letters in any order or position. Each letter is then oriented to the proper position and sped along the conveyor belt to stamp canceler . . .

. . . Letters are canceled by the stamp-canceling machine, which spews them out at 30,000 an hour. They are then routed to clerks who read addresses, feed information to computer . . .

$14 million. This year, the Bureau of Research and Development's budget is $69 million. That's still low in comparison to the total postal budget of $7 billion, but better than nothing.

Thus far, the money has produced only a few islands of mechanization in a sea of hand labor. The most impressive sight in a typical large post office is people—masses of people lugging sacks of mail, sorting letters, stacking trays, and doing dozens of other boring, repetitive tasks. The emphasis on people is a post-office specialty. Whereas a modern industry thinks it has a whopping labor bill if 50 percent of its budget goes for payrolls, the post office is used to spending 80 percent of every budget dollar on personnel.

Fifteen-ton sorter. But mechanization has begun. Take the 78-foot, 15-ton monster called the letter-sorting machine (LSM). If you put a clerk on a stool in traditional style and hand him a stack of mail, he'll do well to sort 1,000 letters an hour into 77 different pigeonholes. Put 12 clerks to work at an LSM and they can sort a whopping 30,000 letters an hour into 277 bins, which means less handling for each letter.

The LSM zips a letter along a conveyor belt and pops it in front of the operator, who has exactly three-eighths of a second to read the address and push the coding keys that send the letter to the right bin.

Mechanized though it is, the LSM continues the post office's reliance on people power; the machine won't work unless each clerk has memorized the code for each of the 277 pigeonholes controlled by the LSM.

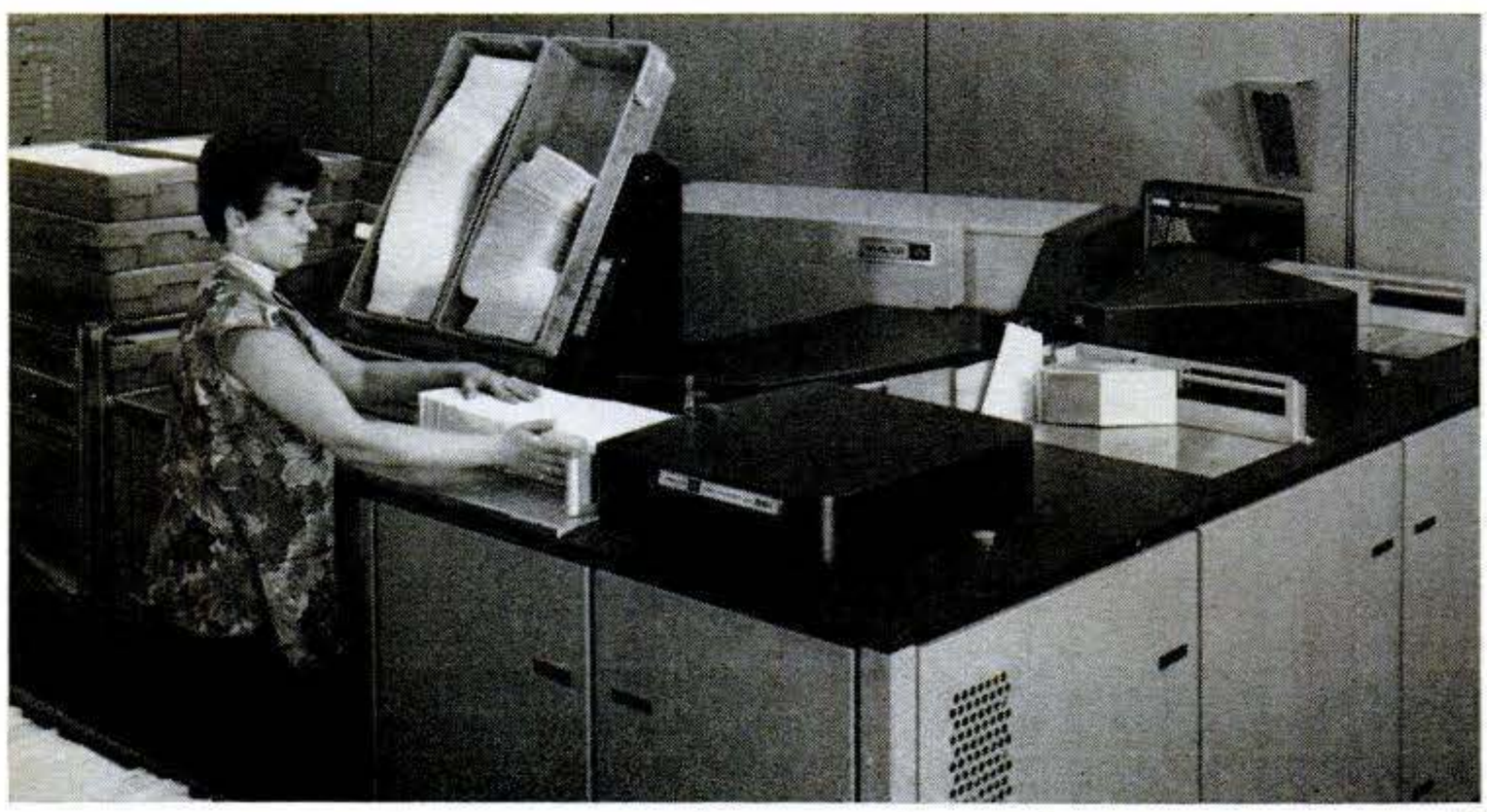
The mechanical reader. A newer wrinkle is to team the LSM with an optical character reader (OCR), a truly space-age machine with many of the capabilities of the human clerk, but few of his human faults.

The OCR has an electronic eye and a computer brain. Letters are whipped along a conveyor belt at 192 inches per second. Each letter stops under a scanner that uses a flying spot beam to locate the address, spell it out, and transmit the information to the computer. In turn, the computer searches a master list of addresses in its memory bank for a match. Once the match is made, the letter is sent on its way to the right pigeonhole. The entire process takes just 86 milliseconds, and what's more, it is 99 percent accurate.

But while the OCR doesn't have human faults, it does have its own machine brand of problems: It can't read handwriting, which bars high-speed handling of mountains of private correspondence. And it has problems with printed addresses, too: Of the 600 different type faces used in the United States, the OCR can read only 80—and then only if the background isn't too confusing for its electronic eye.

Nevertheless, the OCR is one of the post office's shining hopes. Twenty first-generation OCRs are now at work, or being installed, and contracts for second-generation OCRs that will have both better eyes and a better brain have been given to Philco-Ford, IBM, and Recognition Equipment, Inc.

Aside from developing keener electronic eyes, all three companies are trying to develop machines with a little common sense. Today's OCR is



Optical character reader scans 10 addresses a second, compares them with a master list stored in computer. A "match" routes a letter to proper sorting bin.

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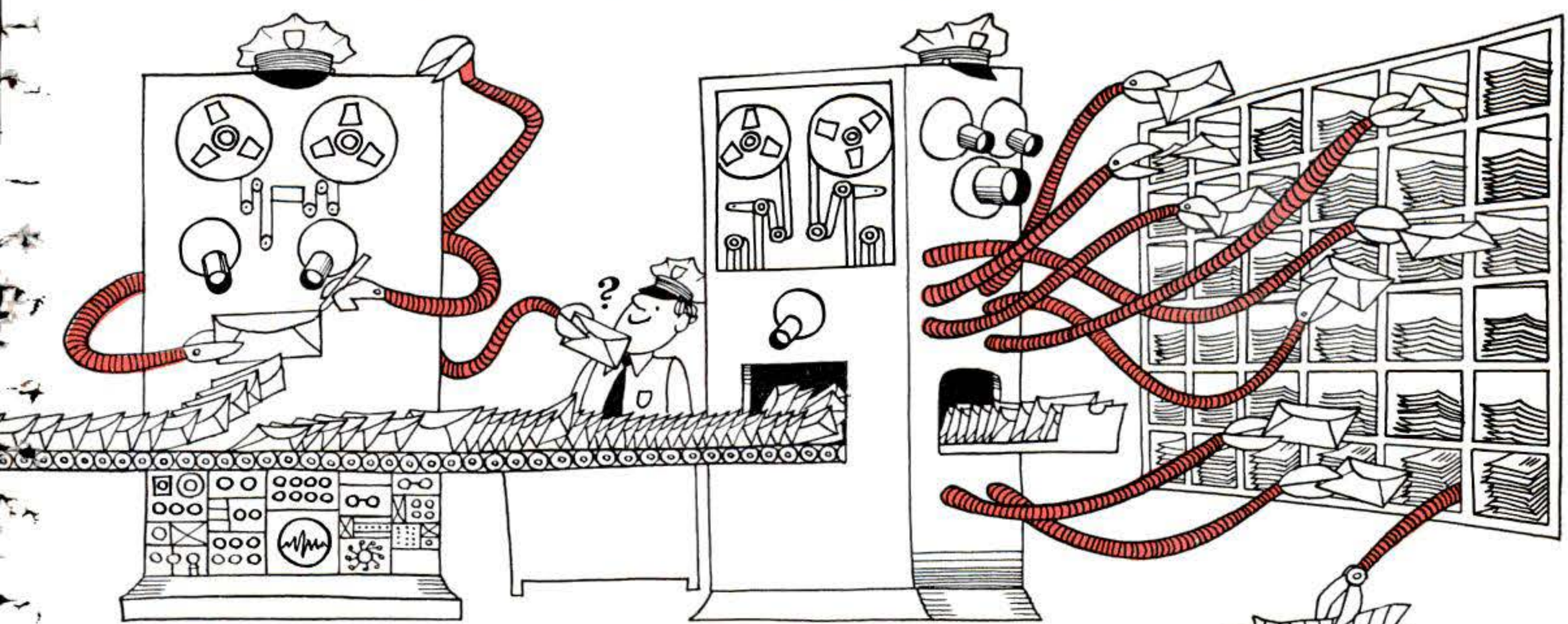
Follow a letter as it gets canceled, coded, sorted, and bundled



. . . After programing by clerks for each letter, the computer rewrites address in code, using phosphorescent ink . . .

. . . Incoming mail goes to second computer, which reads the code and sorts letters into separate bin for each local office . . .

baffled when it runs into an address with a bottom line reading "Attn: Accounting Dept" or something similar. The OCR, searching its memory, finds there's no such city, and spits out the letter. It's hoped that the next generation of OCRs will cope better with such complexities.

But even such improvement won't begin to solve all the post office's mechanization problems. One indication of the complexity of the problems is the paradox that a piece of machinery as fancy as the OCR can occasionally slow down the flow of mail through a post office.

Sure, the OCR is fast and sophisticated—but that just makes it more demanding. Somebody has to cull the letters that the OCR can't handle. Somebody has to trundle a continual supply of letters to the machine. Somebody has to cart off the sorted letters. Add up all the time spent by those somebodies, and there may be a net loss of man-hours compared to stodgy, but steady, manual mail-sorting.

Automation at work. That's why the big gleam in the Postal Service's eye is a new system installed in a Cincinnati post office last August. That system, built by LTV Electrosystems, could be a prototype of the letter-handling system of the future: automation from start to finish.

At the start, outgoing letters pour onto belts that automatically put each one into proper position for the stamp-canceling machine. The letters stream out of the canceler—30,000 an hour—and go directly to clerks who read each address and feed the information to a computer. The computer comes back with a code that is printed on the back of the envelope in phosphorescent ink. From then on, that code determines what happens to your letter.

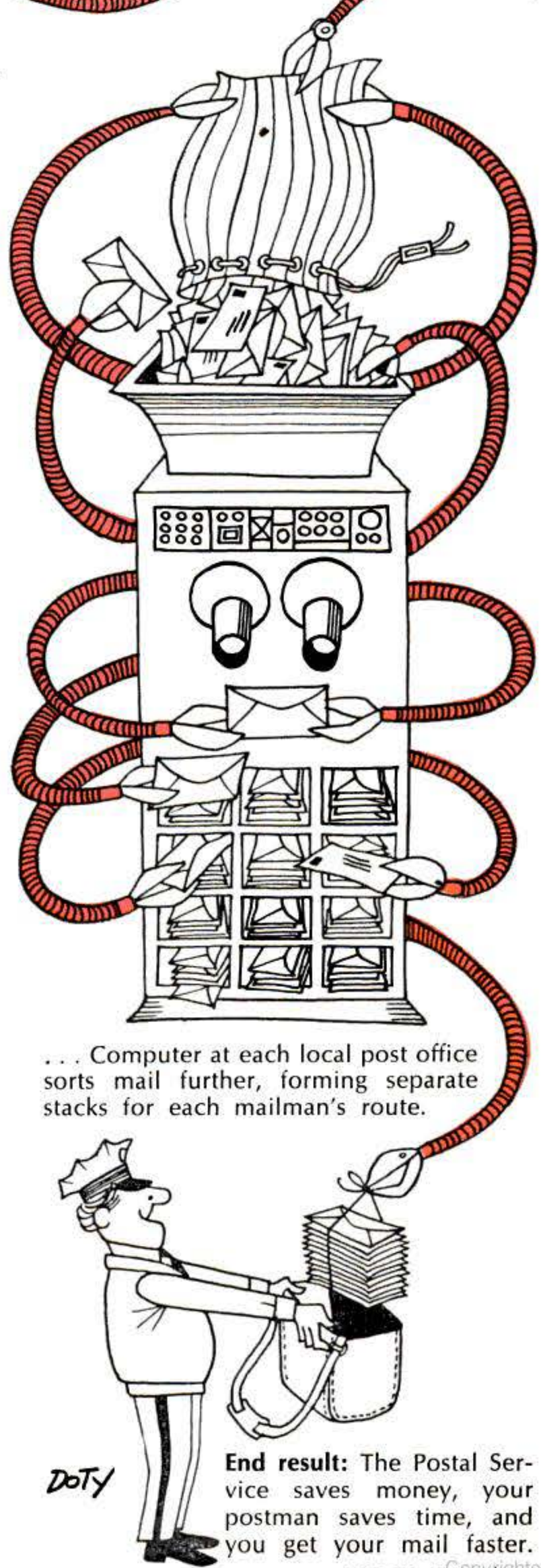
For incoming mail, another computer reads the code and sorts the letters so precisely that the end product is an individual bundle of mail for every postman. The LSM previously described stops its sorting when it has aimed letters at a specific post office. The letter carriers then have to continue the sorting for the individual routes; a process that consumes at least 20 percent of their working time.

For outgoing mail, LTV's system of sorting is almost as precise—except that the same kind of equipment on the other end is needed to realize all the system's efficiencies.

Postal officials hope to have a complete reading on the system after a year's operation. If it works as they hope, the era of the automated post office could be a giant step closer. The man who is watching the Cincinnati operation most closely is Harold F. Faught, a strapping engineer and assistant postmaster general in charge of the Bureau of Research and Development.

Faught views the Cincinnati setup as having about the right combination of far-out equipment and earthy practicality. For example, he likes the system because of the few people needed to tend it. At the incoming end, clerks don't have to carry letters to the personnel who do the coding. Instead, a conveyor-belt system plucks 14-inch stacks of mail from the pile and speeds them to the cod-

[*Continued on page 134*]



. . . Computer at each local post office sorts mail further, forming separate stacks for each mailman's route.

DOTY

End result: The Postal Service saves money, your postman saves time, and you get your mail faster.

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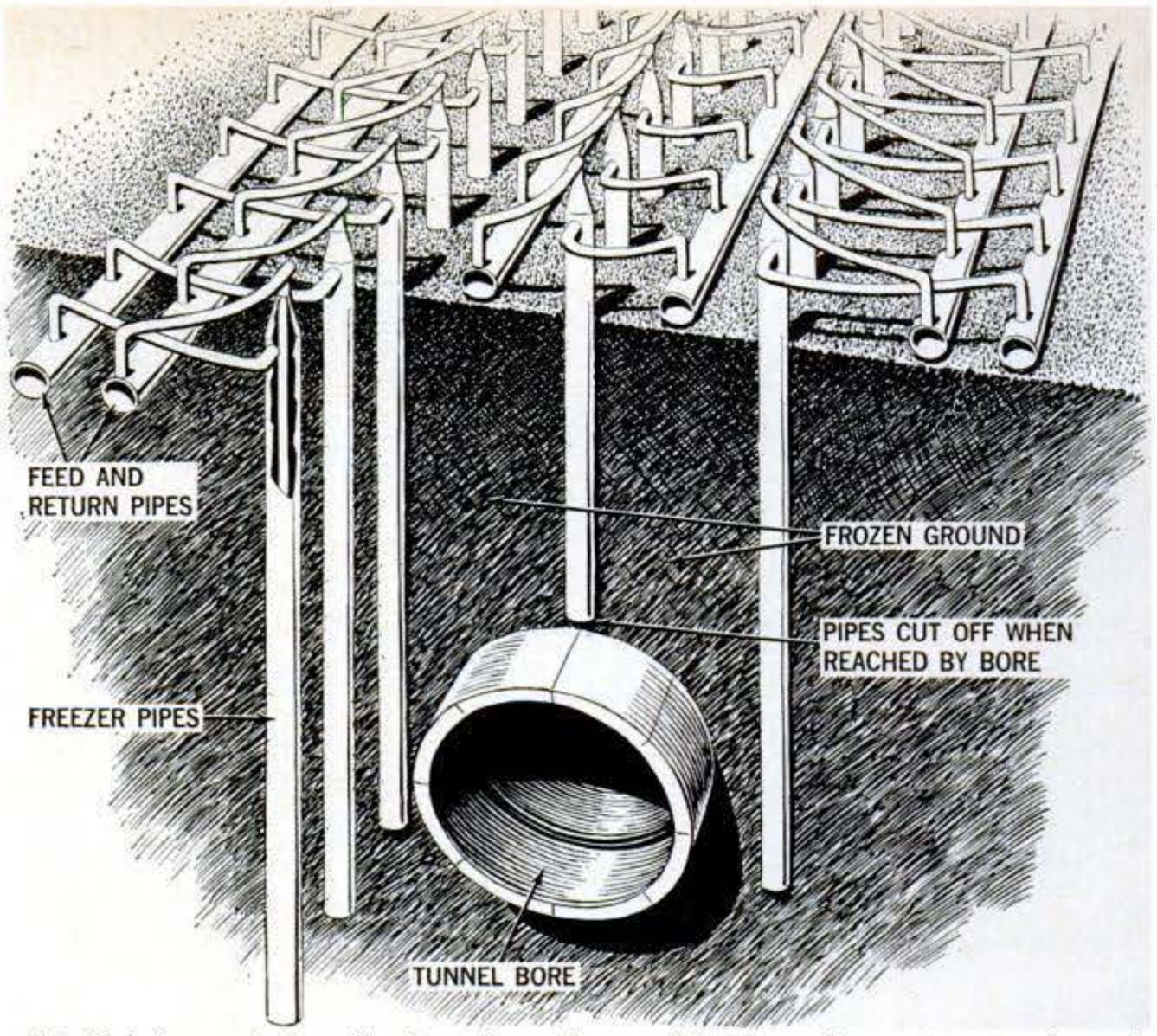
Digging the World's First Freeze-Dried Tunnel

The problem: Cave-ins and flooding in soft-ground tunneling. Solution? Freeze the ground solid

By ERNEST A. ZADIG



Frigid brine solution flowing through coaxial pipes driven in tunnel's path lowers the temperature of the ground to an average of minus 10 degrees F.

We stepped into a huge, rusty steel bucket. The crane picked us up, swung us over a cavernous shaft that seemed bottomless, and in a moment Gus Fleischer, project engineer, and I were zinging down at express elevator speed. I remember offering a silent prayer that the crane operator be on the ball—and his brake bands likewise. Miraculously (to me) we landed with hardly a bump. We got out and started exploring one of the technical wonders of modern tunnel construction.

It felt like walking through a vast, cylindrical freezer. An occasional icicle overhead emphasized the cold. The long rows of frost-covered piping I had seen above ground now began to take on meaning.

This is an engineering "first," I learned from Gus as we walked through the tunnel gloom—the first time ground freezing has been used as an aid to lateral tunneling. The entire complex of sprawling engineering activity is a unit of the North River Water Pollution Control Plant project established by the city of New York.

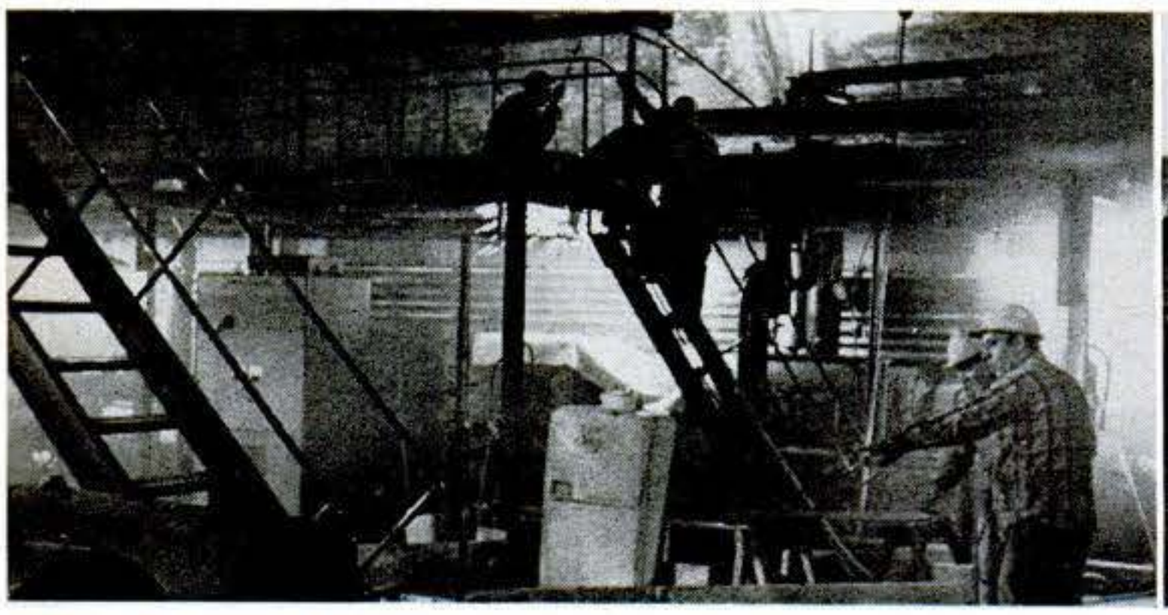
The project parallels the Hudson River in the uptown section of the borough of Manhattan. When completed it will provide a huge, tunnel-like pipe through which sewage will flow to a proposed treatment plant. Like its network of supply pipes, the plant itself also will be underground.

The bizarre aspect of the undertaking is the ground freezing. Nature, during a severe winter, freezes the ground to a depth of perhaps four feet. Here man has frozen the ground to a depth of more than 70 feet! Think of it—a slab of earth more than one-tenth of a mile long, about 27 feet wide, and as deep as the height of a seven-story building—frozen as solid as the food in your freezer.

Why all this fuss with freezing? There are two classic ways to dig a tunnel: either with "free air" or compressed air. The nature of the ground determines the one to use. When you bore through hard rock, the hole is self-supporting and the small amount of ground-water seepage is handled easily by the pumps. You work under atmospheric pressure, dubbed "free air."

When you tunnel through sand and other loose matter, known as "soft ground" in the engineering lexicon, conditions change radically. The only way to keep water out of the bore is to maintain a counterpressure of air. Under elevated pressure, the permissible working time per shift for sandhogs is cut in half, without reduction in full-shift pay. Costs go up as though tied to a balloon.

Night-blasting nuisance. On a free-air job, there is no technical necessity for working around the clock. If the neighbors object to night blasting—as they usually do in urban areas—you simply don't employ a night shift. There is no deterioration in face con-



Inside the pump house, welders on a catwalk prepare a section of pipe used to feed air for working and breathing into the tunnel.

Steel ring sections like these are bolted together inside the bore; then they are coated with concrete to form the tunnel's lining.

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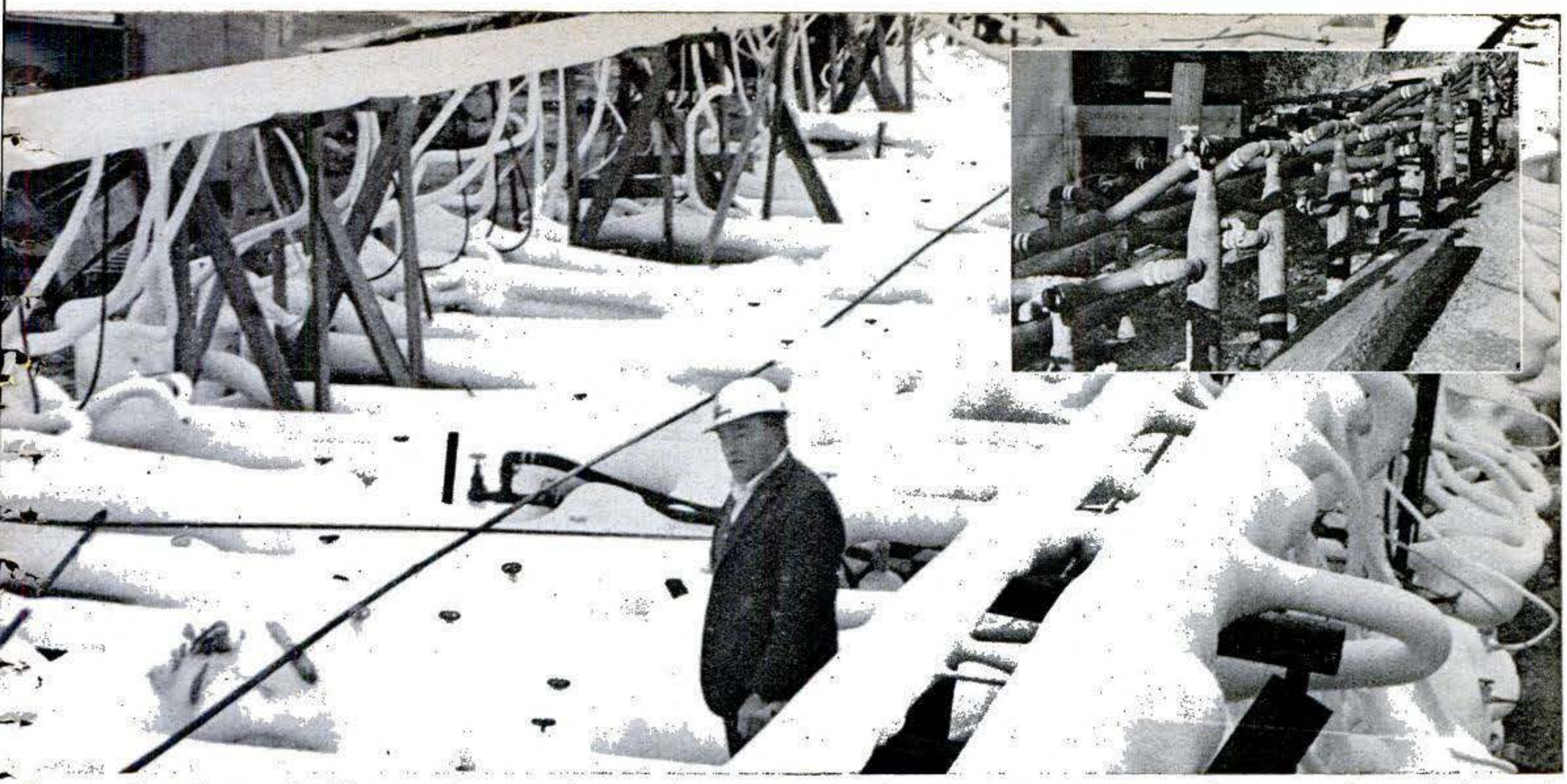

Complicated network of freezer pipes over the tunnel frosts up heavily during summer. Here an engineer is dwarfed by a stretch of the giant cooling setup. Inset shows coaxial pipes before coolant is circulated. Brine flows in the top, out the side tube.

ditions while the tunnel is unattended.

You do not have this freedom of choice on a compressed-air project. The face is treacherous and men must work at it without interruption. The face must be "breasted"—held back by a heavy, assembled shield—before the diggers can be withdrawn. Because it takes hours to construct the breasting and hours more to remove it, the cost factor dictates continuous activity and makes use of a night shift mandatory. This was the dilemma.

The section of tunnel in which we were walking was planned routinely as a compressed-air job because of its soft-ground nature. When the nighttime blasting aroused the anger of the neighborhood, the original plan had to be abandoned. A new method had to be found.

That's how freezing got into the act. It eliminated the need for compressed air—keeping the tunnel dry by freezing the water in the ground around it. At the same time it so solidified the ground that breasting became unnecessary.

To be strictly accurate, the freezing of ground itself is not new. Almost a century ago enterprising German engineers stabilized the ground through which they were drilling a *vertical* shaft by freezing it. One of the present contractors did almost the same thing about 10 years ago in another New York neighborhood. But vertical freezing is a cinch compared to extensive *lateral* freezing. That is why this section of tunnel is a genuine engineering "first"; and it took some trial and error.

The present section of sewage tunnel is the joint venture of a coalition of three contractors: Poirier & McLane, Raymond International, and Nicholas DiMenna & Sons. Each brings a special expertise to the job—especially P&M, with knowledge gained from the early frozen vertical shaft. They were aided in the actual freezing by Lewis Refrigeration Co., specialists in big-scale cold-making.

The plan that finally worked, the one now in use, entailed driving refrigeration pipes into the ground on 30-inch centers to a depth of 70 feet. These pipes are in parallel rows, one on each side of the tunnel run and from one to seven rows between. Each pipe actually is a pipe within a pipe. Cold brine is pumped down the inside pipe, then returns through the outside pipe, extracting heat from the surrounding ground.

A puzzling panorama. Large feeder and return lines carry the brine from and back to the refrigeration machinery. These surface pipes, thickly coated with frost, have attracted the puzzled gaze of passing motorists during the summer months.

Creating all this cold was not all cakes and ale either, I learned from Norb Shauger, engineer for the refrigeration firm. Total refrigeration capacity on the job is 360 tons. You can get an understanding of what this means by imagining 360 tons of ice melting completely within 24 hours! The circulating brine is a solution of calcium chloride in water, and it, too, has idiosyncrasies: Air pockets form to block circulation, and the system must be burped.

The freezing method developed its own quirks, counterbalancing some of its advantages. The ground froze so solid it became almost as hard to cut as rock. Mysterious small rivulets flowed merrily on to prove the old adage that running water never freezes. Here and there a local area refused to freeze for no apparent reason. Despite these minor annoyances, the ground to be bored through is maintained at an average temperature of minus 10 degrees F.

Digging into the frozen earth is carried on behind a shield some 20-odd feet in diameter. As sand and rock are removed, this shield is inched forward by 24 hydraulic jacks on its perimeter. Steel rings formed of nine sections, plus a keypiece similar to the keystone of an arch, are bolted together and into place when the digging reaches full diameter, to form the lining for the tunnel. Concrete poured inside of this continuous ring will form the finished tunnel face.

The City of New York has been dumping torrents of raw sewage into the Hudson River for generations. Now, under the prodding of the Federal Pollution Control Program, the city is mending its ways. The reform is expensive: This one section of sewage tunnel alone will cost upwards of $23 million. But in return the majestic Hudson will get the opportunity to attempt a recovery from its years of insult.

This new engineering twist of freezing the ground to facilitate digging a tunnel also has its little ecological puzzles. For example, the grass in the vicinity of the freezer pipes is the greenest in the park! PS

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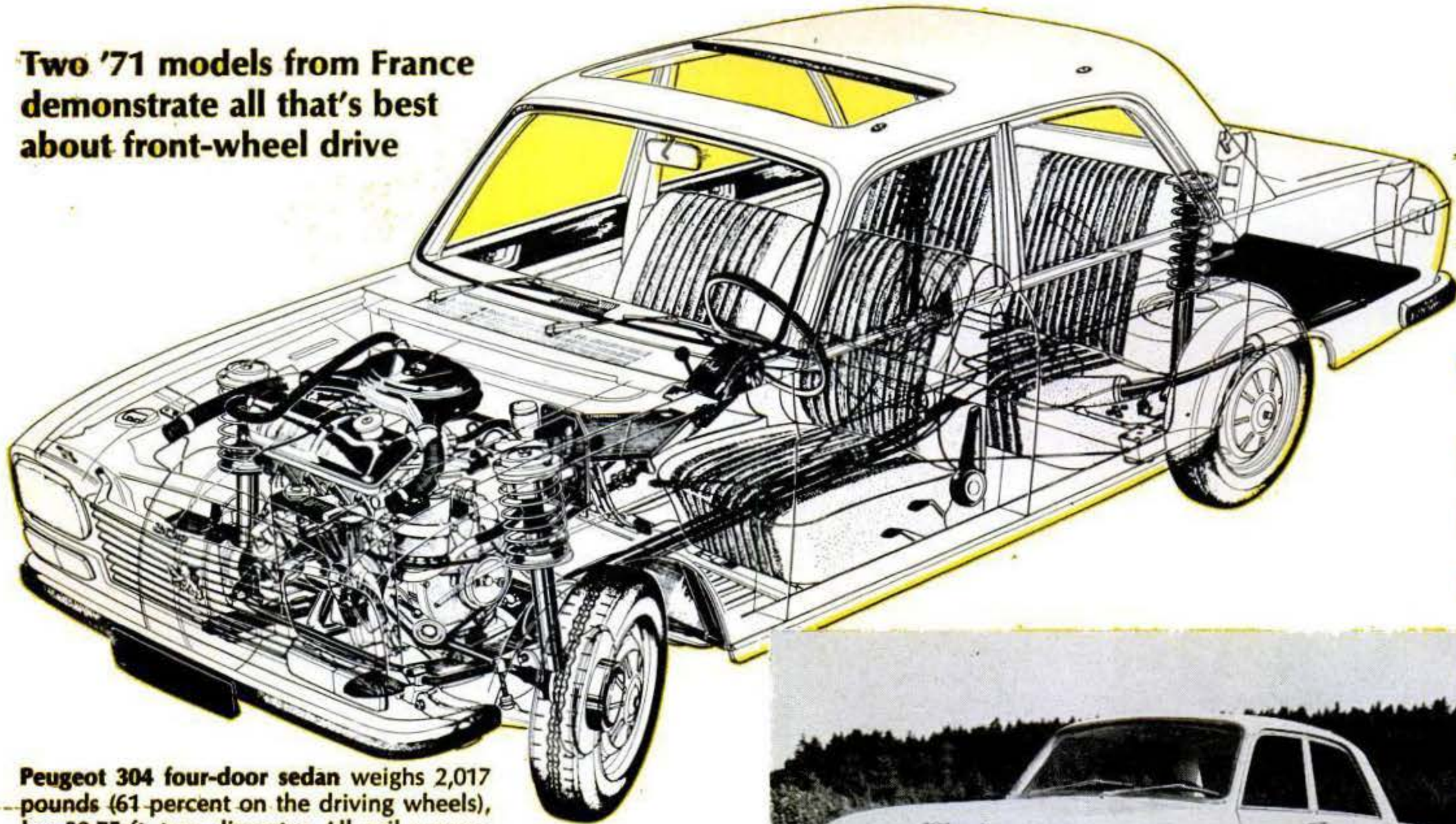
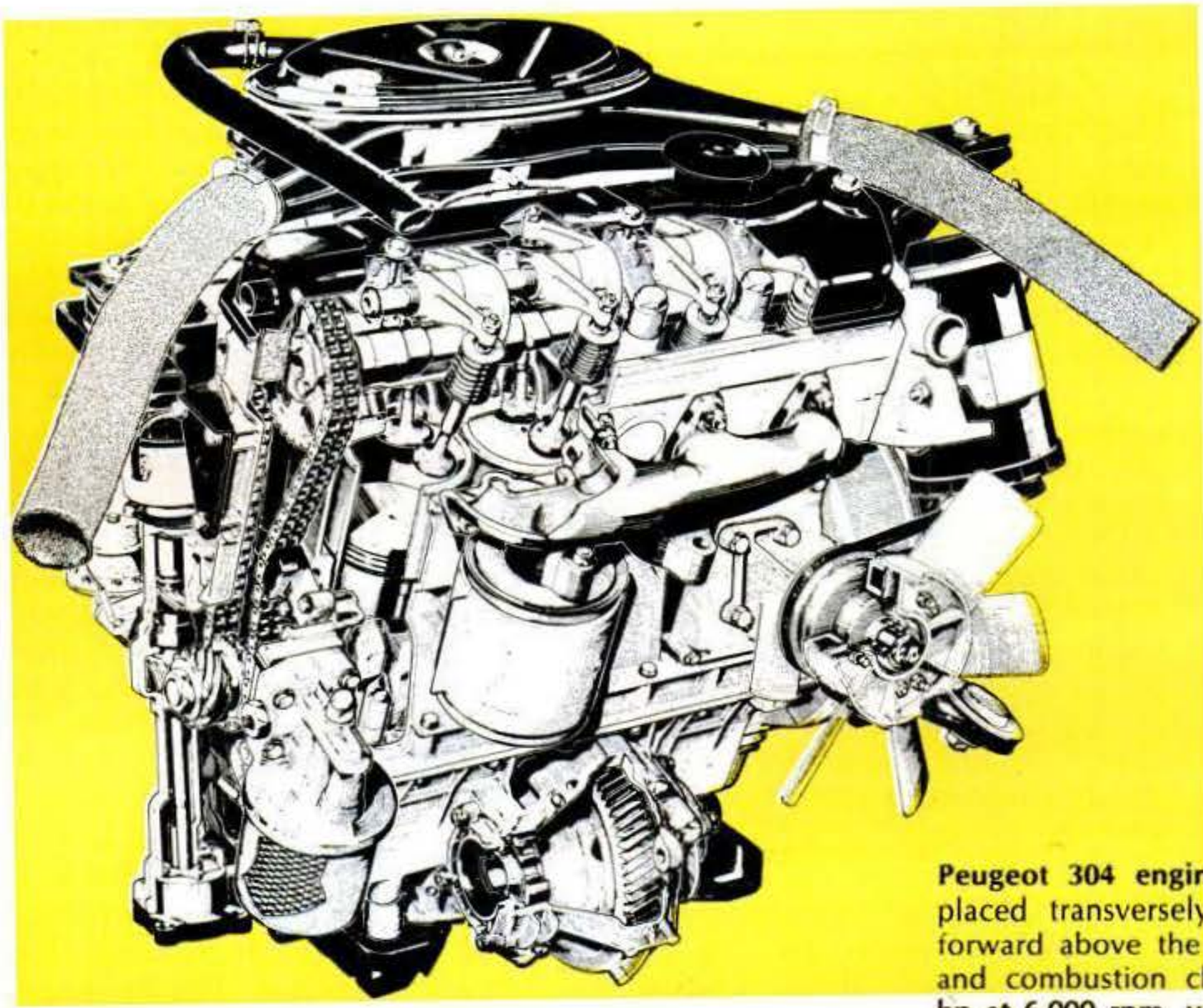
Two '71 models from France demonstrate all that's best about front-wheel drive



Peugeot 304 four-door sedan weighs 2,017 pounds (61 percent on the driving wheels), has 32.75-ft. turn diameter. All-coil suspension is soft, with ride frequencies as low as 60-75 cycles per minute—like air springs.

This Peugeot will accelerate to 60 mph in 16.5 seconds, cruise at 90 mph. We averaged 27 mpg over 2,000 miles. Body is roomy and practical, interior richly appointed. Four-speed synchromesh column shift is standard.

Is FRONT-WHEEL Drive Best for



By JAN P. NORBYE
PS Automotive Editor

Europe says *Yes*. Most modern small cars from Europe have front-wheel drive, even when made by auto makers closely identified with rear engines, such as Volkswagen, Renault, and Fiat. Their rear-engined models are being phased out and front-wheel-drive designs are taking their place. The front-drive VW K-70 and Fiat 128 are not yet imported here.

There are, however, 98 different front-wheel-drive models now made in Europe, and the number will grow. In 1971 Fiat will introduce the 127 and Alfa Romeo will start building the Alfa-Sud, both front-wheel-driven.

Peugeot 304 engine is a 78.6-cu.-in. SOHC in-line four placed transversely in the nose of the chassis, leaning forward above the gearbox. The camshaft is chain driven and combustion chambers hemispherical. It puts out 70 hp at 6,000 rpm, with 69.4 pounds-feet of torque at 3,750 rpm. The block is aluminum, with wet cylinder liners.

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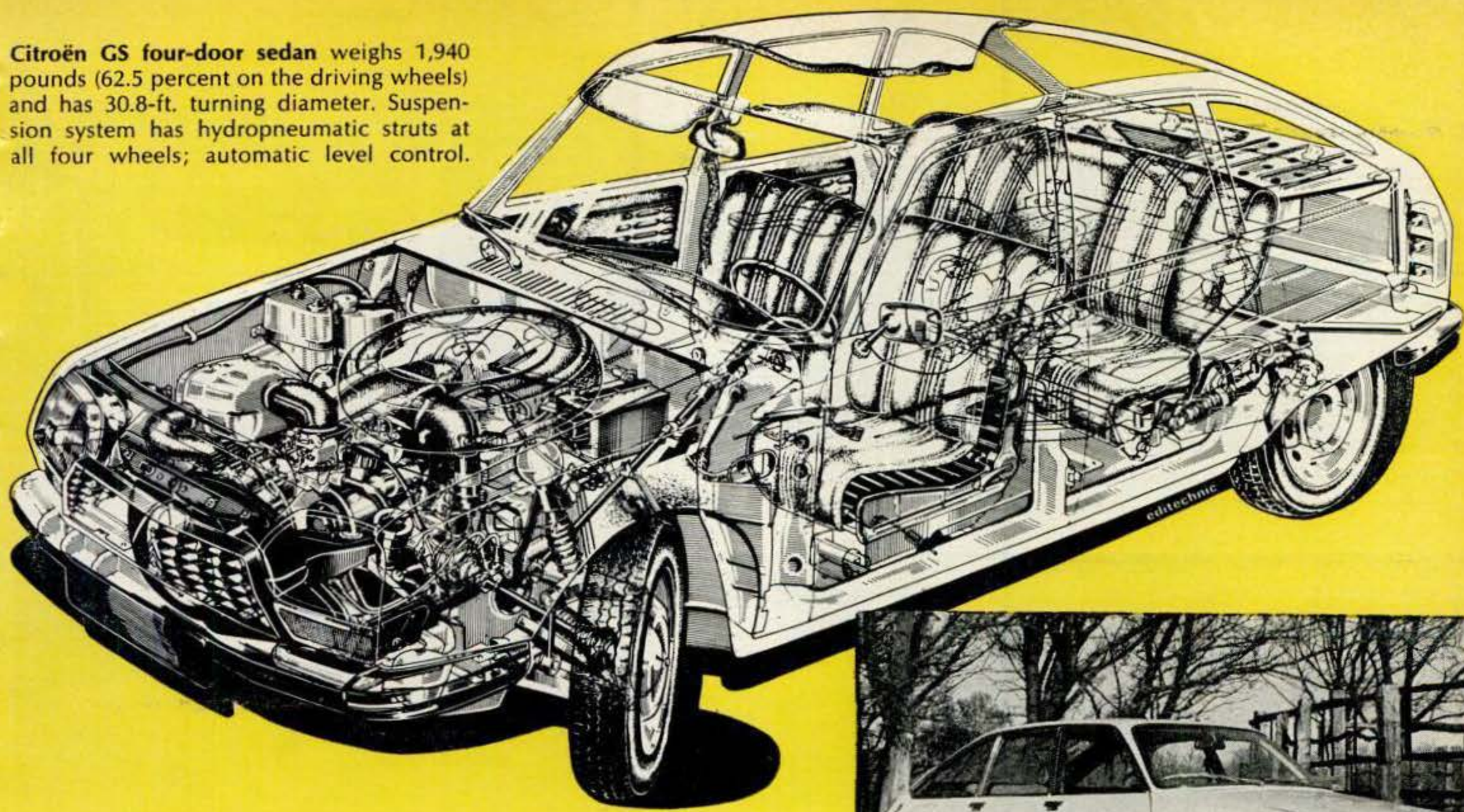

Citroën GS four-door sedan weighs 1,940 pounds (62.5 percent on the driving wheels) and has 30.8-ft. turning diameter. Suspension system has hydropneumatic struts at all four wheels; automatic level control.

The Citroën will cruise in uncanny silence at 90 mph, but 0-60 acceleration takes a full 20 seconds. It's an economy car, capable of 30 mpg (and better). But sporty driving with frequent use of high rpm's brings gas mileage down to approximately 27-28 mpg. This little sedan sets new standards in small-car ride comfort.

Small Cars?

Today, the front-wheel-drive makers are Audi, Austin, Autobianchi, Citroën, Fiat, Innocenti, Lancia, MG, Morris, NSU, Peugeot, Renault, Saab, Simca, Vanden Plas, Volkswagen, Wartburg, and Wolseley. All together, they will probably build three million cars this year.

What's so great about front-wheel drive? I'll answer that first in theory, then by an examination and driving impressions of two: Citroën GS and Peugeot 304.

Front-wheel drive is safer in many ways. With the drive train in the front end, the car gets a low and flat floor. That means a low center of gravity and reduced risk of rollover. Front-wheel drive gives better traction. There's less risk of wheelspin, since the engine and transmission weight fall on the driving wheels.

But, you may say, all this is true of rear engines, too. Right. But if you get wheelspin with a rear-engine car, chances are the tail will skid sideways. There's no risk of that with front-

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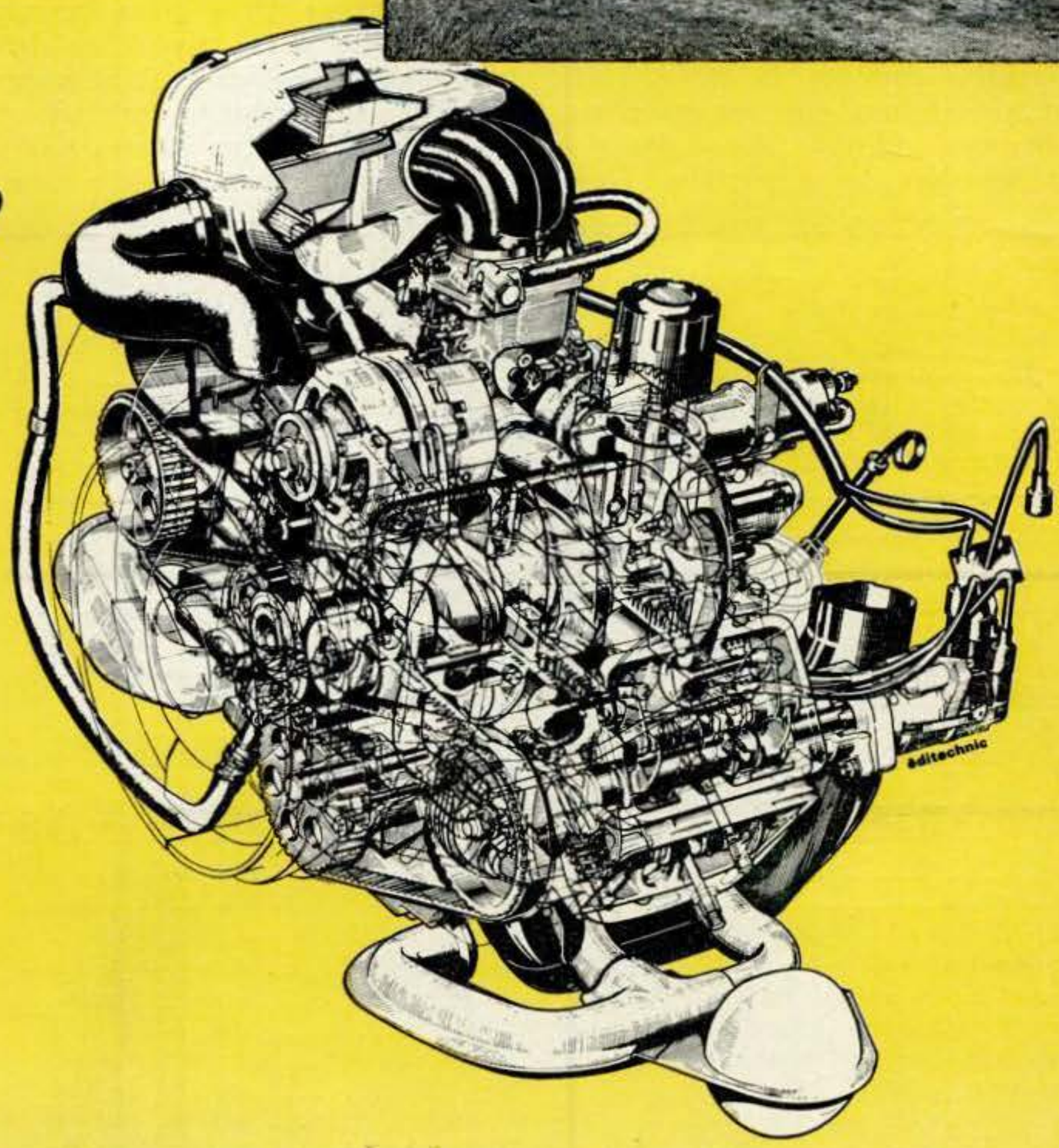
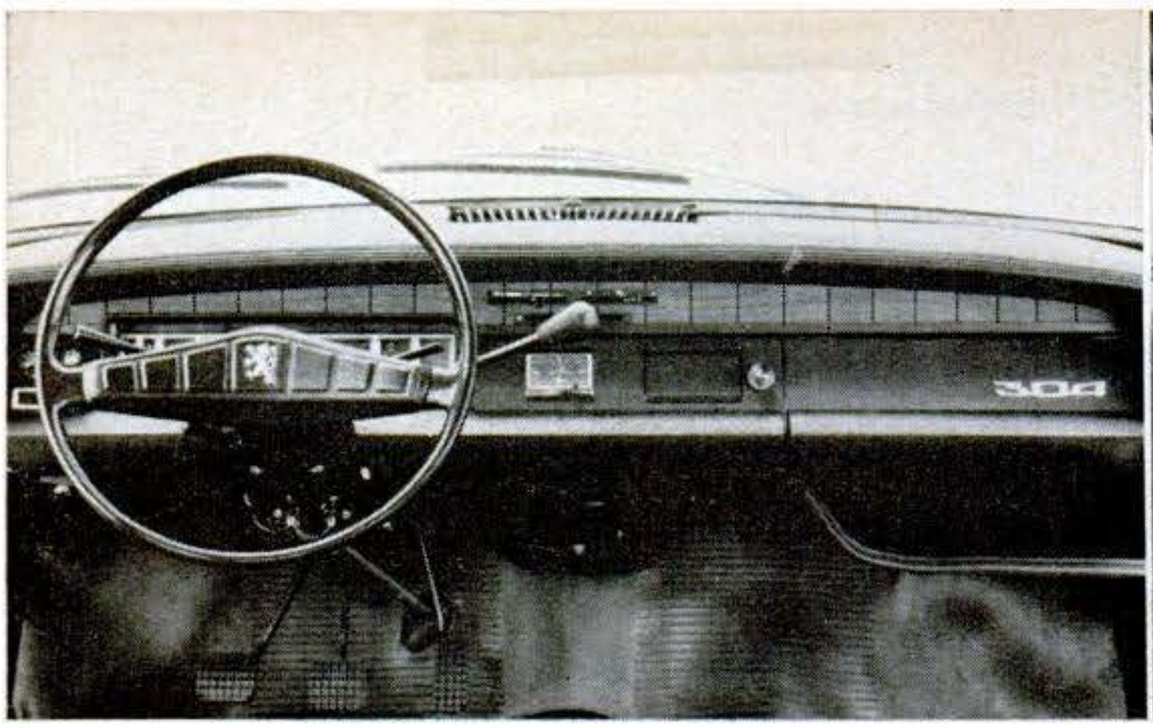
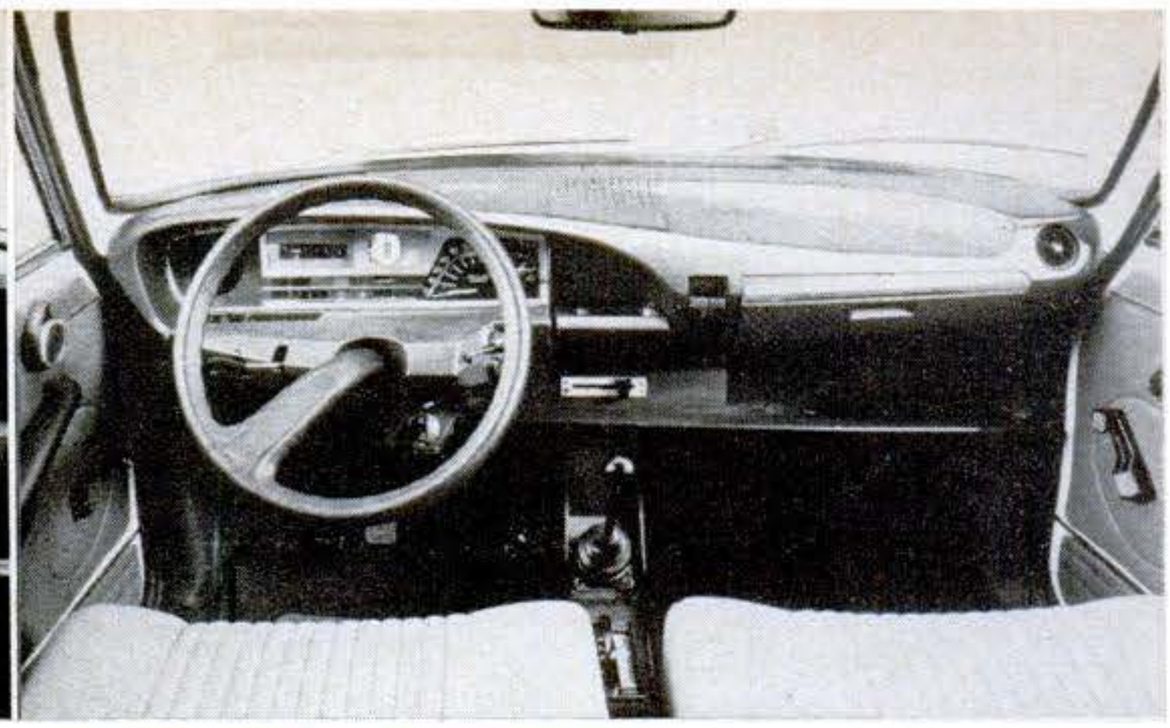


Citroën GS engine is a 61-cu.-in. SOHC air-cooled flat-four positioned ahead of the front wheel axis. Both camshafts are driven by cogged belt, and combustion chambers are hemispherical. It delivers 67 hp at 6,750 rpm, with 54.25 pounds-feet of torque at 3,500 rpm. Four-speed floorshift is standard; no automatic transmission available.



Control panel of the Peugeot is simple, functional, conventional. There's a glove compartment plus a package tray at right.



Citroën GS panel is unusually complete, with a large tachometer as standard, and multitude of color-coded warning lights.

Peugeot 304 is also made as station wagon with four doors. Mechanically, it's identical with the sedan. Cargo area is vast.

Peugeot 304 coupe is a luxurious 2+2 for sports-car fans. It has a four-speed floorshift, but the same engine as sedan.

Peugeot 304 convertible is strictly a two-seater but has luggage capacity for long trips. It also has the four-speed floorshift.

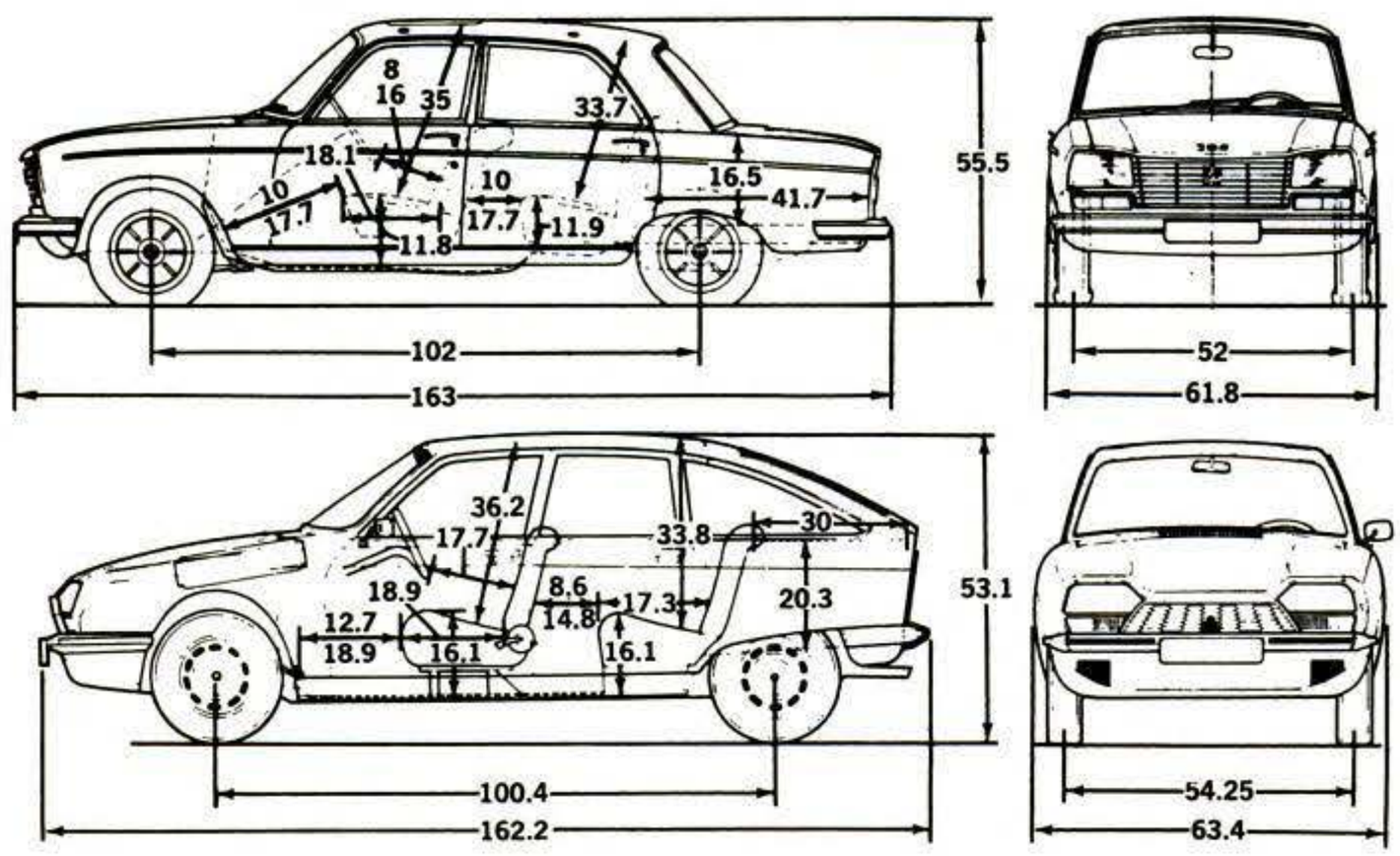
wheel drive. Front-wheel drive cars tend to understeer, which gives safer cornering for non-experts. And it provides better stability in crosswinds. Many rear-engined cars are notorious oversteerers, and have proved dangerously sensitive to sidewinds. Now that's the safety angle. What else?

Front-wheel drive gives far more trunk space than any other drive-train configuration. Rear-engined cars have small trunks (in front) because the wheels need extra room to turn. Conventional cars lose a lot of trunk space to make room for the axle to bounce.

The drawbacks? Front-wheel drive is supposed to give hard steering, vibrations in the steering wheel, and an extra-wide turning circle; to behave funny on turns if you suddenly take your foot off the gas and to lock their rear wheels on hard braking.

All this was true of the 1934 Citroën—and some of it is true of certain 1971 cars. But both the Peugeot 304 and the Citroën GS have lighter steering than many rear-engined cars, and a tighter turning circle, too. They are completely free of vibrations in the steering wheel, and have better handling precision than many sports cars. The Citroën in particular is without vices in this respect. The Peugeot 304 has stronger understeer when you're hard down on the gas than when coasting around a curve, but it is never thrown off balance. Both have brake systems that compensate for weight transfer under braking, and rear-wheel locking does not occur prematurely.

How did they do it? Study the drawings and you'll soon see that these are cars designed with front-wheel drive in mind. No shortcuts were made in the drive train or steering linkages. That tends to bring the cost up. Yes, if front-wheel drive has a problem, it is cost. The drive shafts require expensive constant-velocity universal joints to avoid vibration under all conditions. PS



Dimensions marked on the sketches above are in inches. Both the Peugeot 304 (top) and the Citroën GS (below) seat four. Here are further dimensions and data:

	304	GS
Front-seat width	22.8	22.4
Rear-seat width	49.2	52.8
Min. road clearance	5.3	6.0
Axle ratio	4.06	4.375
Brakes	power	power
front	disk	disk
rear	drum	disk
Tires	radial	radial
Tire size	145-14	145-14
Fuel tank (gal.)	11.05	11.25
Steering	rack and pinion	rack and pinion
Turns, lock to lock	3.75	3.5

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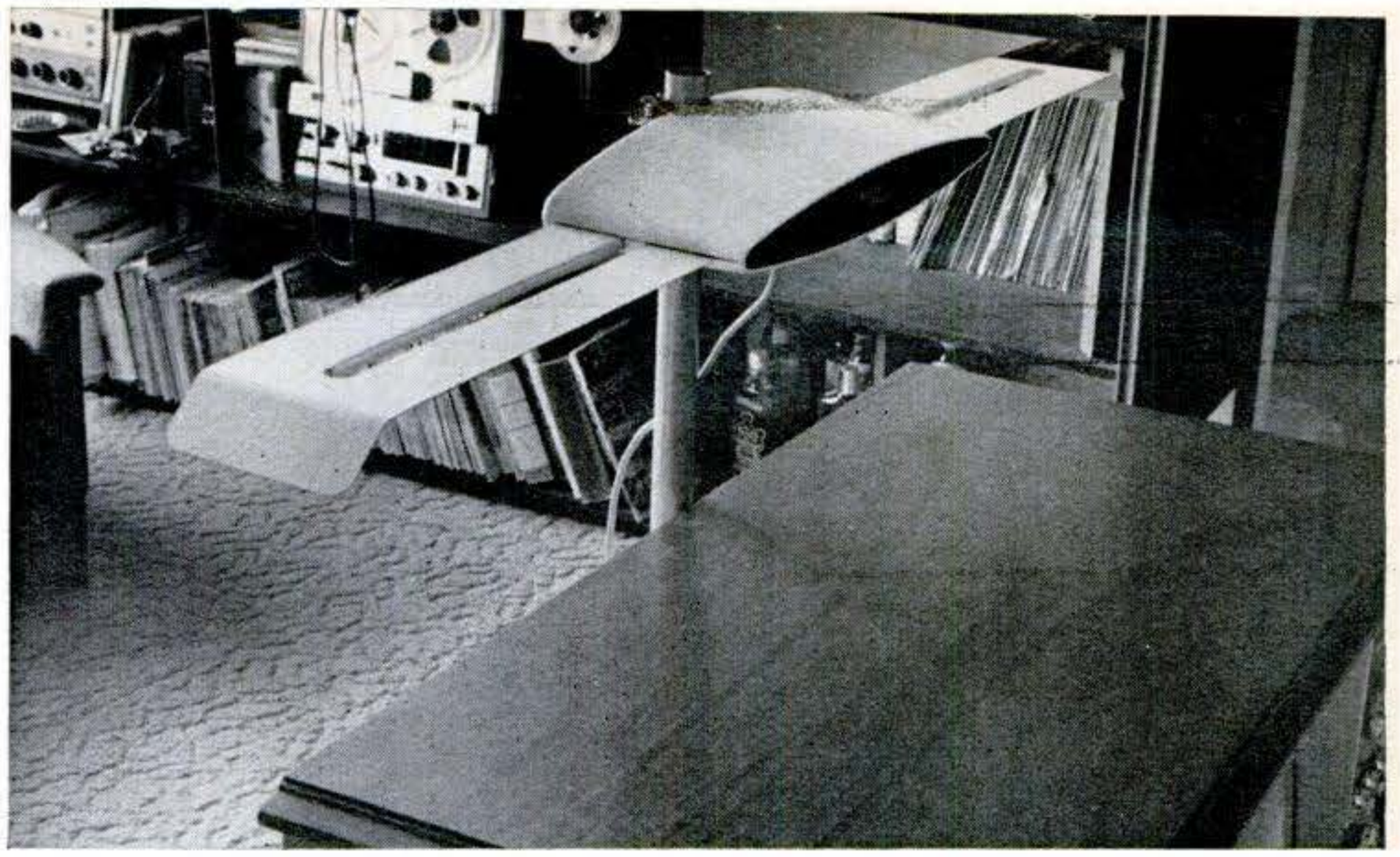
New SAFETY BELT You Can't Ignore

You've seen those clever commercials on TV giving all the stupid excuses people use for not wearing safety belts. Well, now there's a belt that won't take no for an answer. If you don't use it, your car won't start.

It's the AutoSafe interlock belt system developed by Irvin Industries of Greenwich, Conn. The system includes electric wiring, attached to the seat-belt webbing and connected to the ignition, and sensors in the seat cushions that are activated by the weight of anyone sitting on them. If a belt in any occupied seat isn't fastened, the ignition is dead.

That's not all. There's a mercury switch in the buckle. Locking the belt around you puts the switch in position to indicate that the belt is *worn*. You can't defeat the system by fastening the belt and pushing it aside. It's now under test by the government—*Herb Shuldiner*

This driver can't start his car because his AutoSafe seat belt remains unfastened. The system prevents a car from starting unless every rider has buckled up. Sign on dashboard (bottom) lights up to warn driver he's got a no-go situation.



PERSONAL-USE REPORT

Little Antenna with a Big Reception

Antenna manufacturers are continually seeking new designs for the ultimate in television reception, and we users have paid for it by having to drape their plumber's nightmares on our chimneys, roofs, or windows.

Now Winegard comes to the rescue of the homeowner with the little Sensar SR-20. It's just under four feet long and six inches wide. An RF amplifier built into its molded body makes up in signal strength for the antenna's small size.

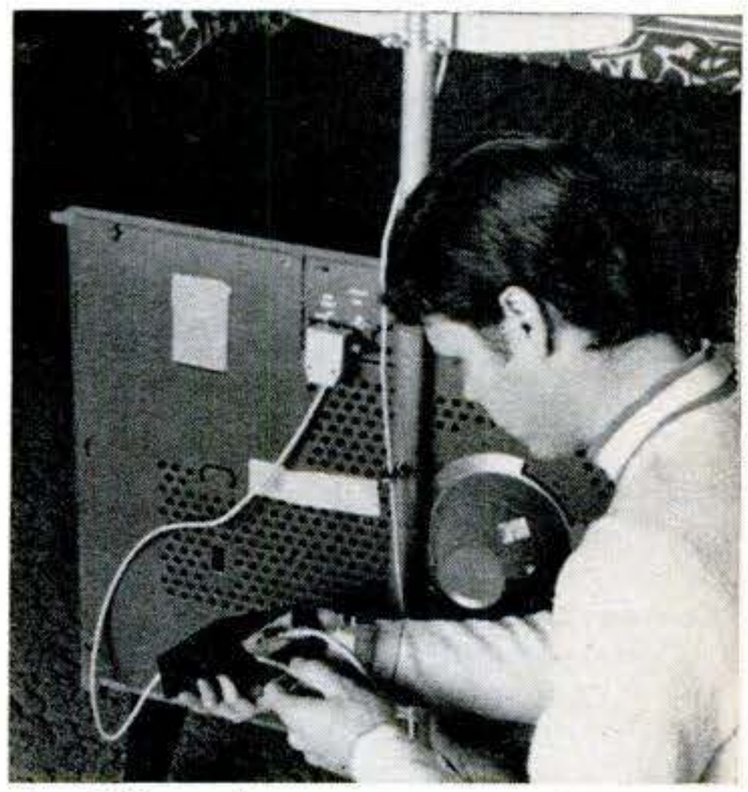
How does it work? Maximum recommended distance from the transmitter is 40 miles; my home is 35 miles distant and I received a sharp, clear color picture with the antenna mounted in my attic. Its overall size, which at first strikes you as merely nice, I found to be a true virtue in installation—especially if you own a trailer or have a crawl-space attic. You can also mount it on a TV set.

A single 75-ohm coaxial cable connects the antenna to the power supply —which both supplies the operating voltage for the amplifier and receives the transmission signals.

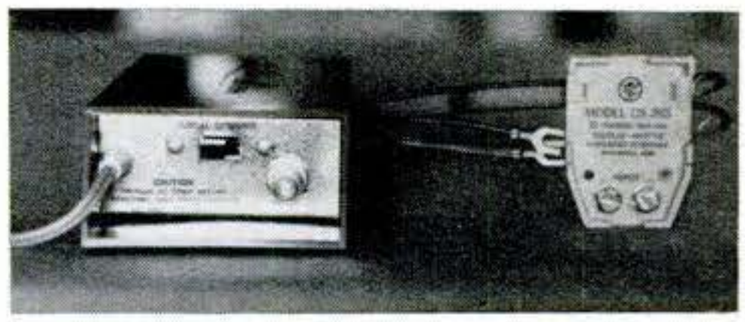
Operating off house current, the supply contains a signal-control switch for 0 or -20db attenuation of signal at its output and, when connected to the band separator, supplies signal to both VHF and UHF channels—no need for an extra antenna.

I found the wiring straightforward and simple—for most connections requiring just a twist of a connector.

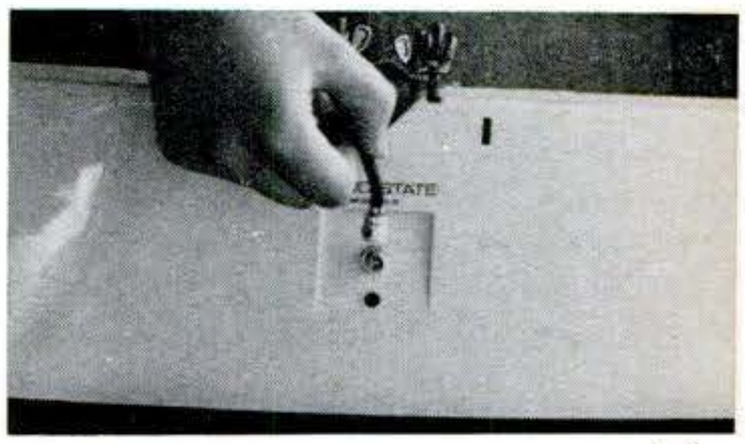
The basic antenna includes all items except optional mounting fixtures and extended lengths of lead-in wire. List price for the Sensar SR-20 is $49.88.—*William Hawkins*



Signal from the antenna goes through the power supply to the band separator; 75-ohm coaxial cable is used throughout.



Power supply (left) supplies 12 volts to antenna and provides signal to band separator (right) for UHF and VHF receivers.



Pilot lamp below antenna connector lights up when all connections are properly made. A single connection hooks the antenna in.

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A multi-g human centrifuge performs an operation too delicate for surgery—and an emergency rocket-control idea yields a wheelchair you can steer with your eyes

Medical Spin-Offs from the Space Program

By DR. WERNHER von BRAUN
NASA Deputy Associate Administrator
PS Consulting Editor on Space

Sight-controlled wheelchair is tried out by Dr. von Braun. Facing straight ahead, he steers battery-powered chair in desired direction just by turning his eyes sideward. Learning how to run it took him only 10 seconds.

For the first time in medical history, in late 1968, an astronaut-testing human centrifuge was drafted to save a life by moving a bullet fragment in a holdup victim's brain. The dramatic case was just one instance of new medical wonders that have come about as dividends, or "spin-offs," from our space program.

All of us benefit by these medical spin-offs from space. They enter into everyday life at home, office, and factory, as well as at the doctor's office and the hospital. Too numerous even to list here completely, they speed recovery from ills, allay suffering, and enable the handicapped to live a useful and enjoyable life. Here are just a few examples:

The life-saving centrifuge

Shot in the head by a robber, Joseph Barrios, 63, of Morgan Hill, Calif., was rushed to a San Jose hospital. Finding the bullet had shattered, surgeons extracted all but one fragment, which they dared not try to reach. X-rays showed it was in a critical region of Barrios' brain —and was gradually shifting, imminently threatening to reach a fatal spot.

The only hope was somehow to move the fragment out of harm's way—and the hospital enlisted the aid of NASA's nearby Ames Research Center. Ames had a human centrifuge, a whirling cockpit in which astronauts undergo many-times-normal gravity for space tests and research. With a duplicate of the bullet fragment and a model of gelatin, which simulates the consistency of the human brain, Ames doctors rehearsed an emergency plan to move the fragment with the centrifuge.

Brought to Ames, Barrios was carefully positioned in the cockpit, helmeted and wearing astronaut-style gear to telemeter his pulse rate, breathing rate, and electrocardiograms. As the centrifuge spun, a TV camera eyed his face, and instruments monitored his condition. He whirled for nearly a half minute, at a force up to six g's—which in effect multiplied his weight six times—and was able to smile and chat with the doctors when he emerged. The centrifuge "operation" was a success, later X-rays showed. The bullet fragment had been shifted to a region where it would be harmless, and embedded and immobilized there.

Eyes steer a wheelchair

For a paralysis-stricken person who cannot use a standard wheelchair, NASA has come forth with a mechanized chair controlled by a "sight switch," originally born of a space need. During my years at the Marshall Space Flight Center we were looking for a way to aid astronauts in an emergency if high g forces rendered them unable to move their arms or legs. Suppose, say,

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an out-of-control rocket vehicle spun or gyrated so wildly as to pin them helplessly to their couches; how could they cut off the engine? One clever answer to the problem was a sight switch built into a pair of eyeglasses.

A tiny lamp on each side of the frame bounces an invisible beam of infrared light off your eye and back into a photocell, which senses the difference between the white of the eye and the darker pupil. Turn your eyes, and the reduced reflection—as the pupil crosses the light-beam's path—activates an electric switch.

Plainly this switch can be applied, too, to brighten the life of a victim of paralysis. It can control room lights, a thermostat, or a TV set, or turn the pages of a book. Just as well, it can start and stop a motorized wheelchair—and steer it, too. You look to the left once to start, again to stop, again to reverse. You look to the right to turn right; again, to turn left.

How simple it is to use an eye-operated wheelchair, I saw for myself, when a battery-powered electric version was built and tried out at the Marshall center. It took me just 10 seconds to learn to run it. A beginner's only likely mistake, I found, is to glance out of the corner of his eye at the instructor beside him. This operates the eye switch and evokes an unexpected change in the chair's motion. To view anything to one side without doing so, you turn your whole head.

A car that walks

From a proposed design for a lunar crawler has come a walking car—especially suited for crippled children, who take delight in operating it. Wheelless, it travels on eight legs—powered by a battery and electric motors—and has two speeds in forward and in reverse. Its novel method of locomotion enables it to ride over curbs (as pictured on the next page) and even up stairs. The rider guides it simply by pushing an upright control stick in the desired direction.

To the moon and Mars, medicine owes other advances, some of which may touch your life more closely:

- If that X-ray of your innards isn't as clear as your doctor needs for a sure diagnosis, it can now be made more revealing. "Computer enhancement," a technique developed to bring out obscure details in photos of the moon and Mars (by enhancing contrasts, for example) has lately been applied with striking success to improving medical X-rays. (See photos, next page.)
- Measuring the oxygen you consume during exercise formerly required you to wear a nose clip and breathe through a mouthpiece. Now you breathe freely in a modified astronaut's helmet, sealed at the neck, with an air inlet on one side and an outlet to a suction pump and air analyzer on the other. Youngsters enjoy donning the "space helmet" for a clinical test.
- Because lubricants evaporate in a vacuum, NASA has sought to reduce friction in metal-to-metal bearings for lunar vehicles. From its Lewis Research Center at Cleveland have come antifriction bearings of new titanium alloys, with a hexagonal crystal structure instead of the usual cubic one. If current trials at Cornell Medical Center confirm that these alloys can safely be implanted in living tissue, they promise artificial hip joints of greatly improved mobility and comfort, to replace damaged human ones.
- Already proven compatible with fluids and tissues of the human body is a high-purity, high-strength form of carbon developed in NASA experiments requiring instruments to be implanted in animals' internal organs. Medical use of this new "biocarbon" for artificial heart valves and other human implants is now foreseen.
- Learning to walk on artificial legs is made easier

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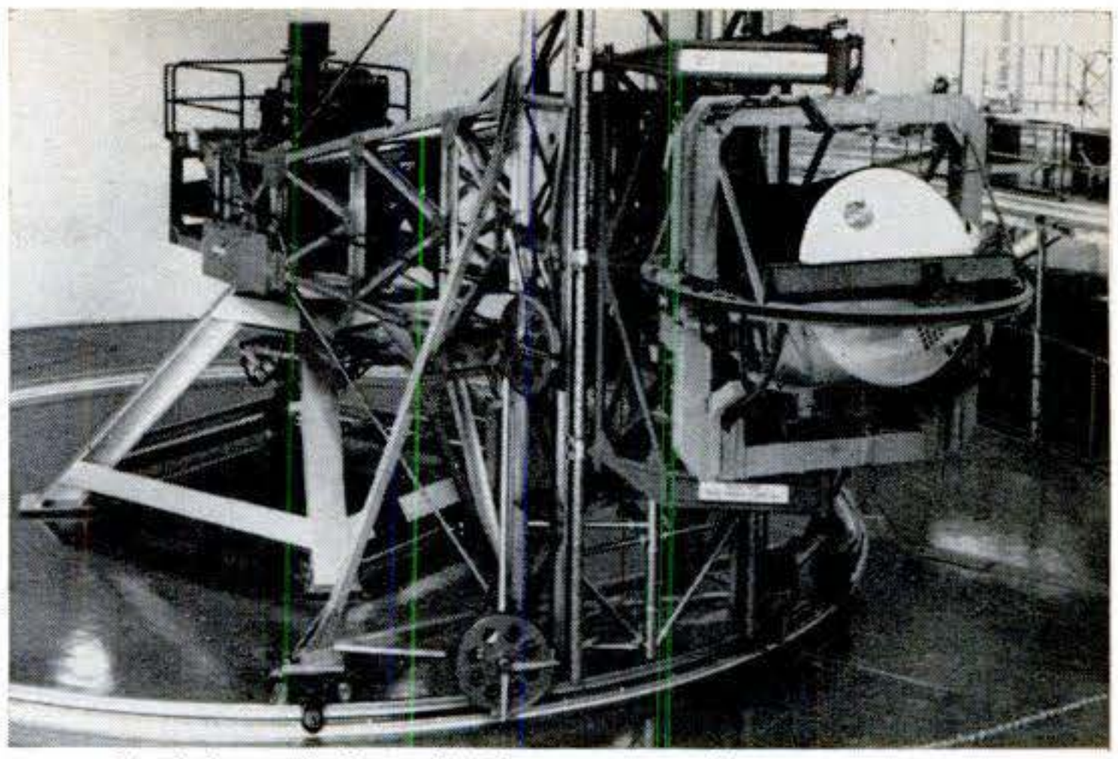
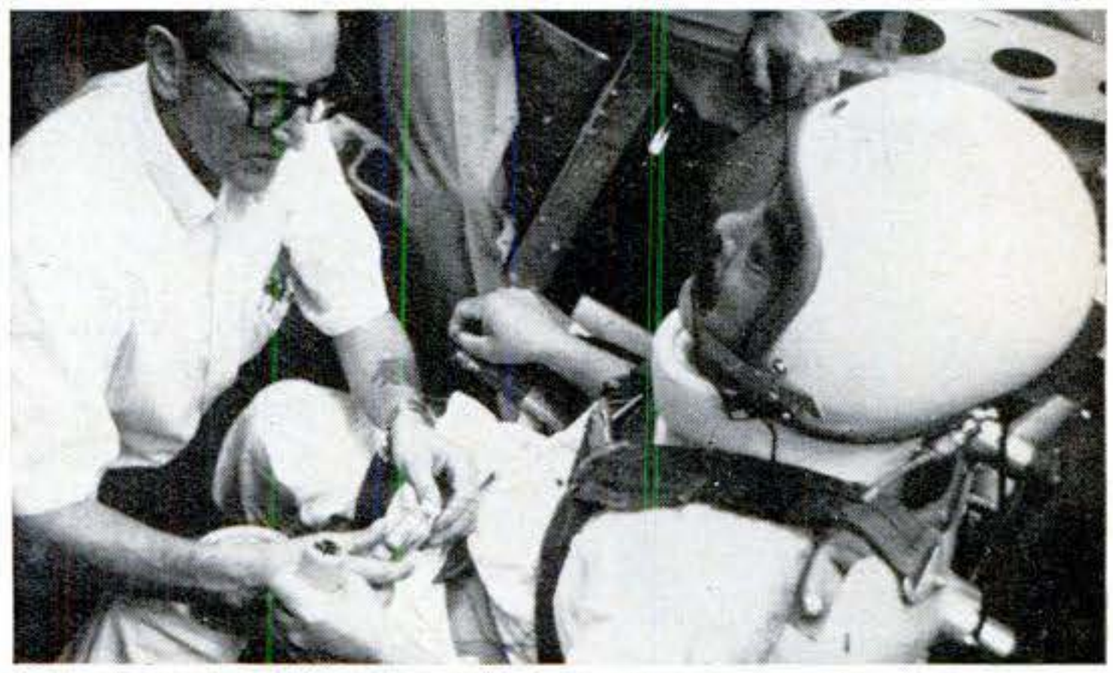
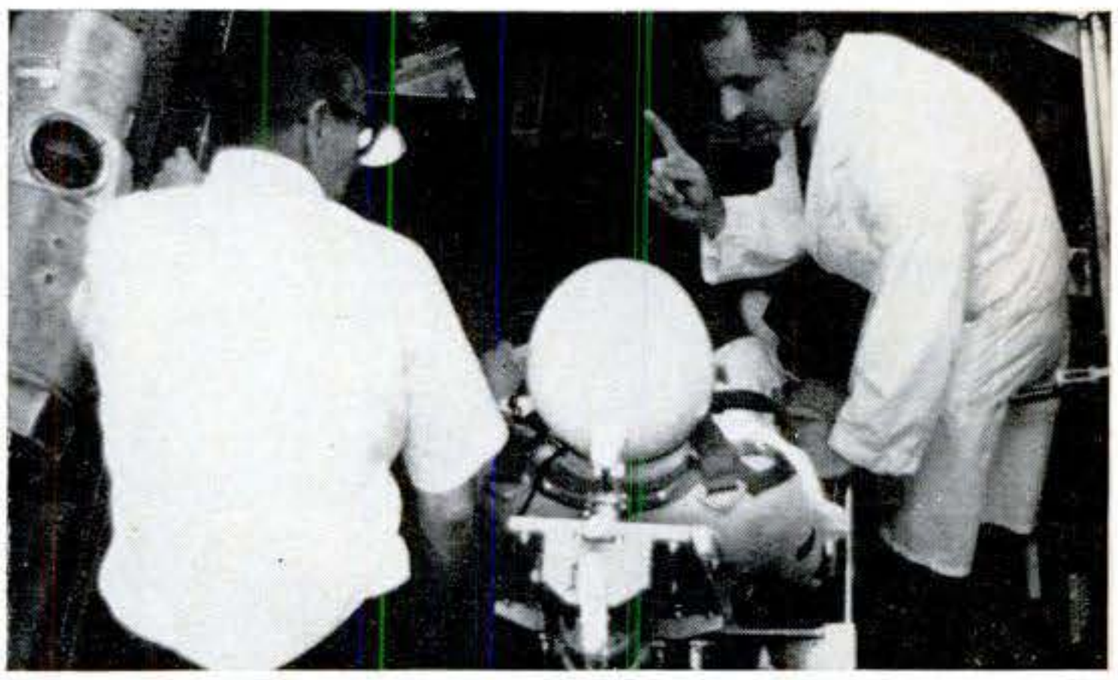


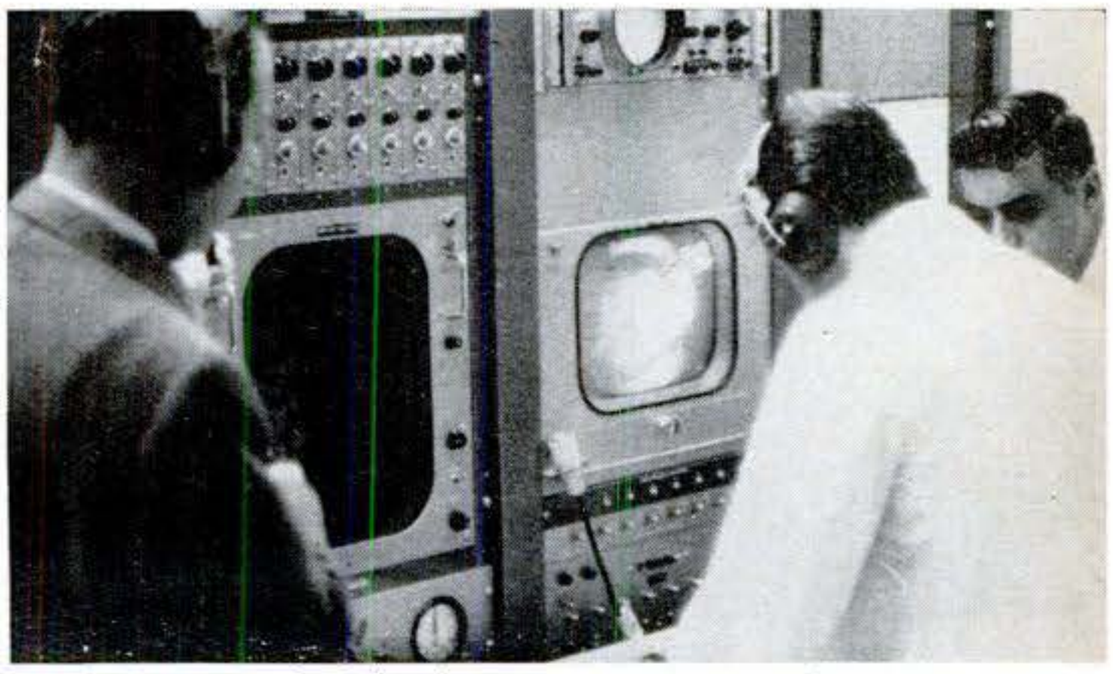
In medical drama below, this human centrifuge saves a man endangered by bullet fragment in his brain, beyond reach of surgeons.



Holdup victim Joseph Barrios is readied in centrifuge for use of its six-g force to move fragment from perilous area to safe one.



Placed so force will tug in right direction, Barrios (in helmet) gets final instructions. Then the centrifuge is set whirling.



Brief ride is watched by doctors at TV screen of monitoring console. It succeeds in moving bullet fragment out of harm's way.

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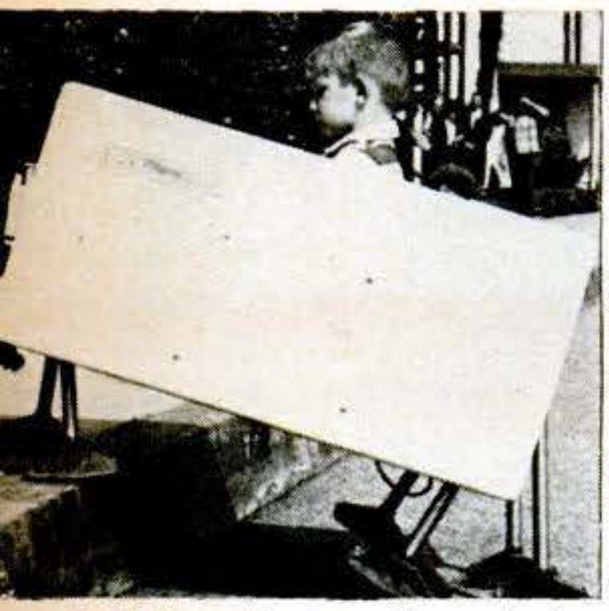
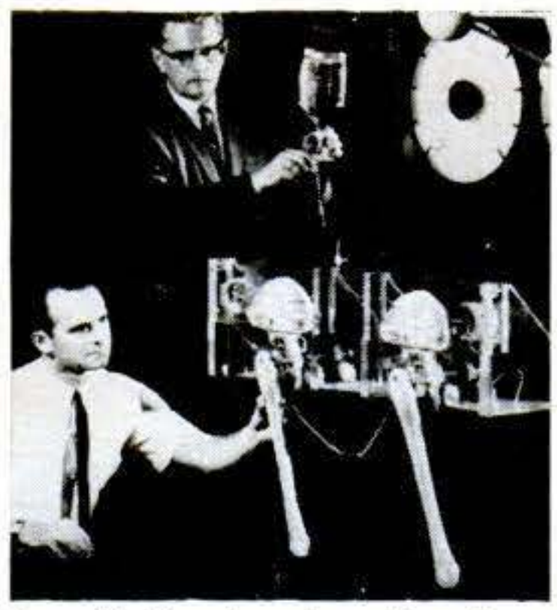
New spray-on electrodes (inset above), applicable as shown in about three minutes, enable a heart-attack patient's symptoms to be radioed ahead to hospital by ambulance rushing him there. Doctors will then be ready with immediate aid when he arrives.

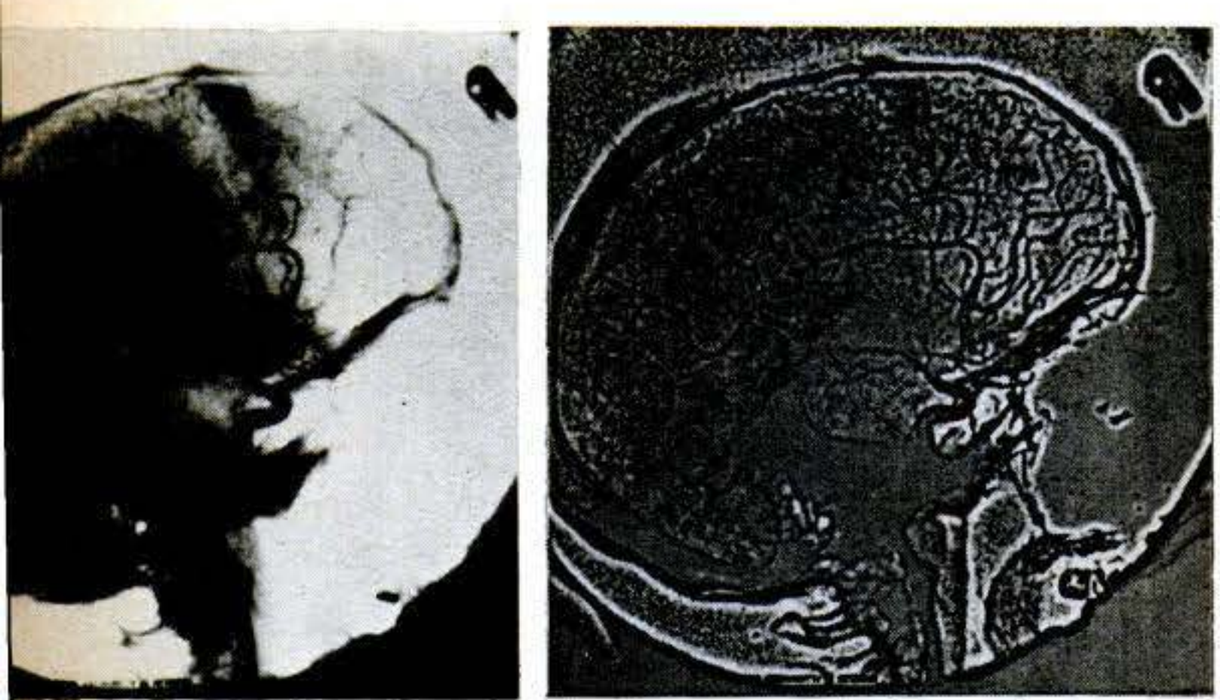
Remote monitoring is becoming major aid for intensive care. Baby recovering from surgery, left, wears radio transmitter that sounds alarm and brings nurse on the double if sensor detects breathing difficulty.



Eight-legged car, patterned after proposed moon vehicle, gives crippled child an enjoyable way to get around. It walks over curbs and up stairs.



Low-friction bearing alloy from space lab shows promise for repairing human hip, in this hip-joint simulator at NASA's Lewis Research Center.



X-rays gain clarity by technique that improved photos of moon and Mars. Frontal blood vessels of head, obscure in X-ray at left, stand out strikingly in a "computer-enhanced" version at right.

by support with a weight-reducing sling, similar to a device that trains astronauts to walk on the moon, where gravity's force is one-sixth of that on earth.

Electrical monitoring is proving a magic gift to medicine as well as to the space program.

Astronauts wear harnesses of electric wires with skin contacts, so ground observers can check their physical condition in flight. Early hookups were delicate; their metal-disk contacts sometimes came loose or made imperfect connections. Now NASA has developed "spray-on electrodes," quickly and firmly attached to your skin by spraying a fast-drying conductive mixture over a wire's end. What results is a thin, flexible disk-shaped contact able to withstand vigorous exercise, though easily removable at will. This practical way to wire you up offers a variety of medical uses.

To picture one likely application in the not-so-distant future, suppose you have a heart condition that calls for careful watching. Wearing spray-on electrodes, you can go about your daily business, while your electrocardiograms are taken by a tape recorder no larger than a pack of cigarettes, carried in your pocket. At the end of a week you put the tape in an envelope and mail it to a Central Medical Computer Office. There a computer compares it with a record of your heart's normal performance, already on file. If the computer detects a significant departure from your "norm," your doctor will be notified, and you'll be advised to make an early appointment to see him.

While this plan is not yet operational, other important medical uses of spray-on electrodes already are.

The next ambulance that passes you, siren screaming, may be speeding a man with a heart attack to the hospital. Possibly too, even as it weaves through traffic, it may be radioing ahead the man's electrocardiograms to the emergency ward, via spray-on electrodes. By the time he arrives there, doctors will know the nature and severity of his attack and can give instant aid. First introduced in Los Angeles, the radio-ambulance technique looks ready for widespread adoption.

Boon to intensive care

Perhaps the most important contribution of NASA medical spin-offs is in the field of intensive care.

Electrocardiograms, other cardiac information, and data such as breathing rate and fever temperature, picked off from the patient's body with spray-on electrodes and various sensors, are transmitted by wire or radio to a central computer. The computer's memory is preloaded with the data normal for the patient and any variations in the incoming data are detected by comparison. Alerting the nurse, it gives her a simple print-out of the patient's name and room number and the nature of the abnormal condition.

Thousands of Americans are now alive because of these new monitoring techniques, which are becoming more and more widely used from coast to coast. Some 100,000 more lives could be saved yearly in the U.S. alone, it has been estimated, if we could make the most of our hospitals' intensive-care wards.

Automated monitoring of patients offers an answer to what has been the principal problem—the legions of attendants that have been needed to keep a 24-hour vigil over other legions of intensive-care patients. Thus it holds the hope of slashing the high cost of intensive care to patients—and of easing the plight of the many hospitals that lack enough personnel, or the funds to pay them. Without computerized intensive care, our Apollo/Saturn space vehicles with their legions of subsystems would never have carried our astronauts to the moon and back. PS

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Historic call introducing video telephone age is made to Alcoa's board chairman, John Harper, by Pittsburgh's mayor (picture on screen).

It's Here... See-While-You-Talk Telephone Service

By JOHN R. FREE

A telephone call that began, "Good morning, John, you're looking well this morning," introduced a new era in communications last year. Pittsburgh's Mayor Peter Flaherty was addressing—and viewing—Alcoa's board chairman, officially putting video telephones into service in the U.S.

With Picturephones rolling off the assembly line, the Bell System's see-while-you-talk service will spread fast. In two years, Chicago, New York, Detroit, Washington, Newark, Cleveland, Philadelphia, and Pittsburgh will be linked. By 1975, some 100,000 sets, distributed in 24 cities, will be operating.

Some companies and institutions are using sets for in-building video intercoms. President Nixon's key White House aides are using Picturephones on an experimental basis.

Can you get video telephone service in your home? Picturephone service probably will be used mostly by business for the next 10 years, according to Bell. Costs for complex equipment and special wiring are high. Initially, the Picturephone monthly rate is $160.

Although the Picturephone itself [see "Amazing New Picturephone," PS, June '68] is a marvel of electronic hardware, it's little more than a two-way TV set compared to the sophisticated network being built to transmit pictures from city to city.

Getting a picture. A TV camera tube, specially developed for the job at Bell Labs, is mounted just above the 5-by-5½-inch TV screen. The camera tube's nickel-size target is an array of over 500,000 light-sensitive silicon diodes. This solid-state target has several advantages:

- It's rugged and has a long life.
- It can provide a good picture with normal room light.
- It permits electronic (rather than optical) zooming.

You adjust knobs on a cable-connected control unit to zoom in for a smaller field of view. Flipping up a 45-degree mirror in front of the camera, for example, enables you to show a drawing placed on the desk before the Picturephone. The electron beam scans a smaller area of the image on the target, but the picture still fills the screen.

Talking to computers. By punching up the right code on the Touch-Tone telephones used with Picturephones, engineers can "talk" to computers to obtain charts, graphs, and statistics. A lightpen or special keyboard may be included with future sets for interaction with displays—erasing and manipulating them.

Existing telephone wiring is used as much as possible for Picturephones, but modifications are necessary to carry the video signal. Wiring in a city telephone exchange cable may have up to 1,100 pairs of 22-gauge wire. A Picturephone requires three of these pairs, or six wires: a pair for audio, and one pair in each direction for video.

Piping your telephone conversa-

[Continued on page 130]

Picturephones rolling off a Western Electric assembly line will rent for $160 a month.

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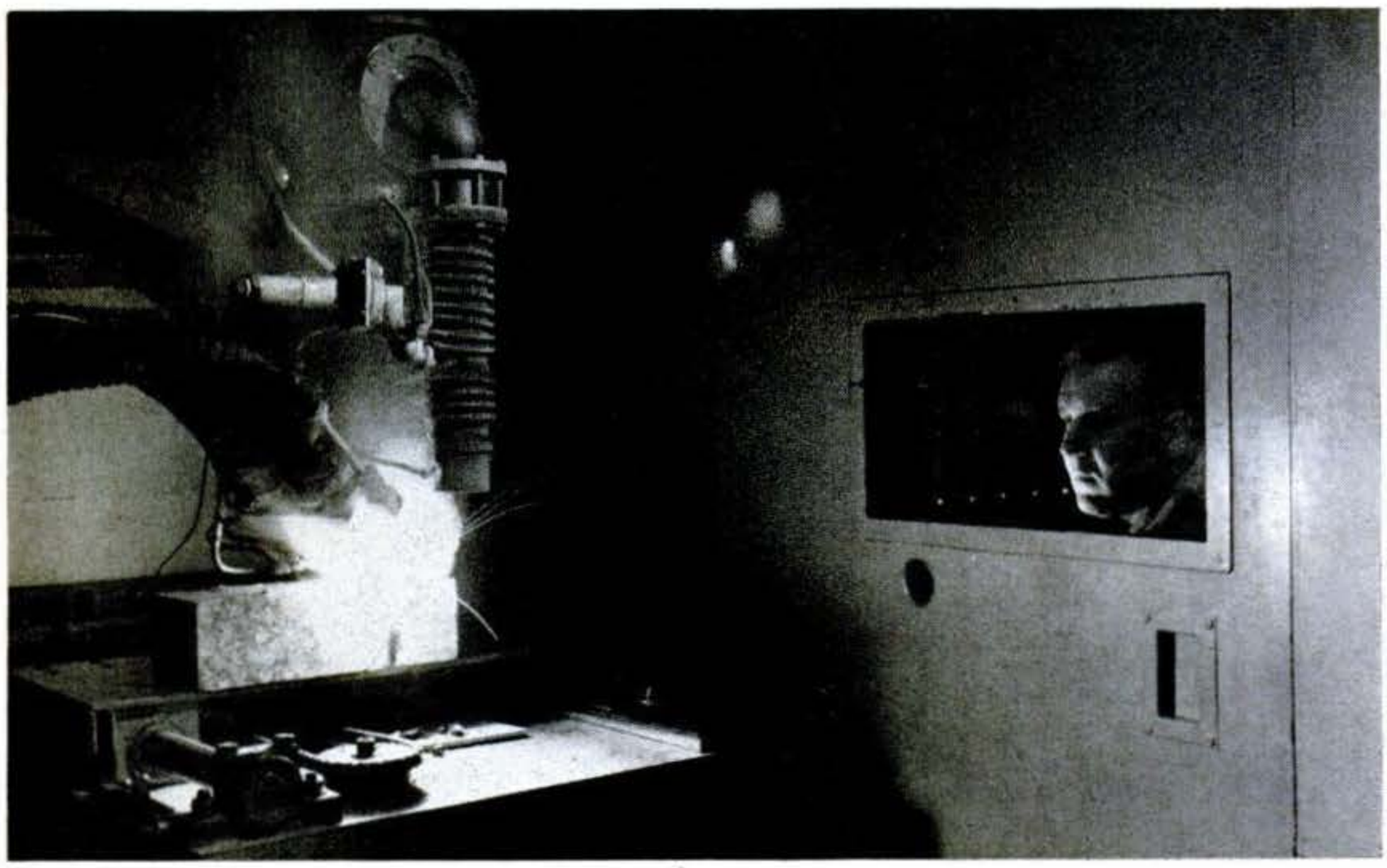
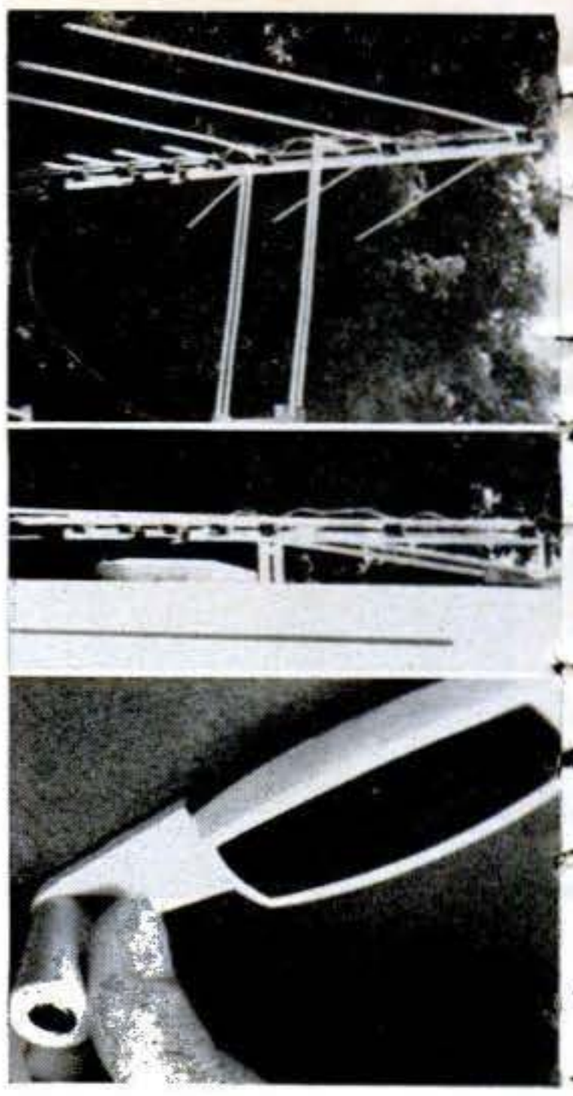
What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS





For TV in your RV ▲

No need to step outside your recreational vehicle to ready this antenna for action. A crank on the RV ceiling elevates it 27 inches, unfolds it as it rises, and turns it 360 degrees for best reception. It's made by Braund Mfg. Co., 730 E. Michigan Ave., Battle Creek, Mich. 49017.

▲ Hot way to cut rock: an electron beam

A beam of electrons like the one that paints the picture on your television screen—only many times more powerful—may be tomorrow's jackhammer. A prototype electron-beam rock cutter by Westinghouse will go through many types of rock, cutting like a hot knife through wax. When fully developed, the concept could be used to bore tunnels, to quarry rock such as granite, or cut up city streets for utility lines. At present, the experimental cutter penetrates four inches into rock, employing a 9,000-watt beam.

◄ Self-analyzing car

Built into the wiring of each new BMW car is a series of 14 sensing circuits linked to a multi-pin socket. Connect it to the cable of this special electronic analyzer and you get a complete engine diagnosis in 12 minutes. Test results emerge on a 14-line print-out sheet.

Blow-up bridge ▲

Engineers figure it would take soldiers 30 minutes to unpack, inflate, and place a 60-foot bridge—like this Goodyear model—across a stream or chasm. An entire convoy—including 20-ton tanks—could then cross. Repacking the bridge for re-use also takes 30 minutes.

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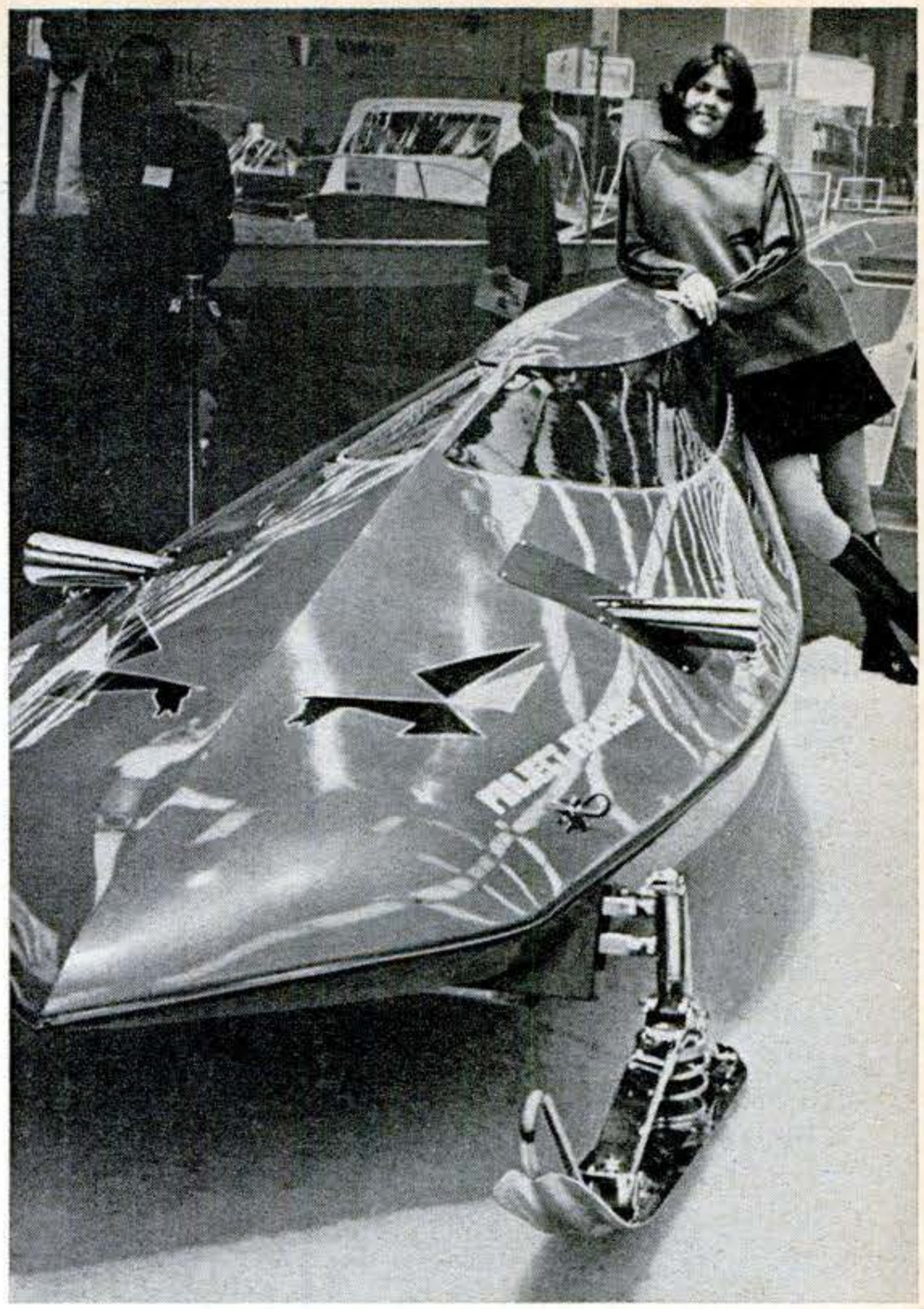
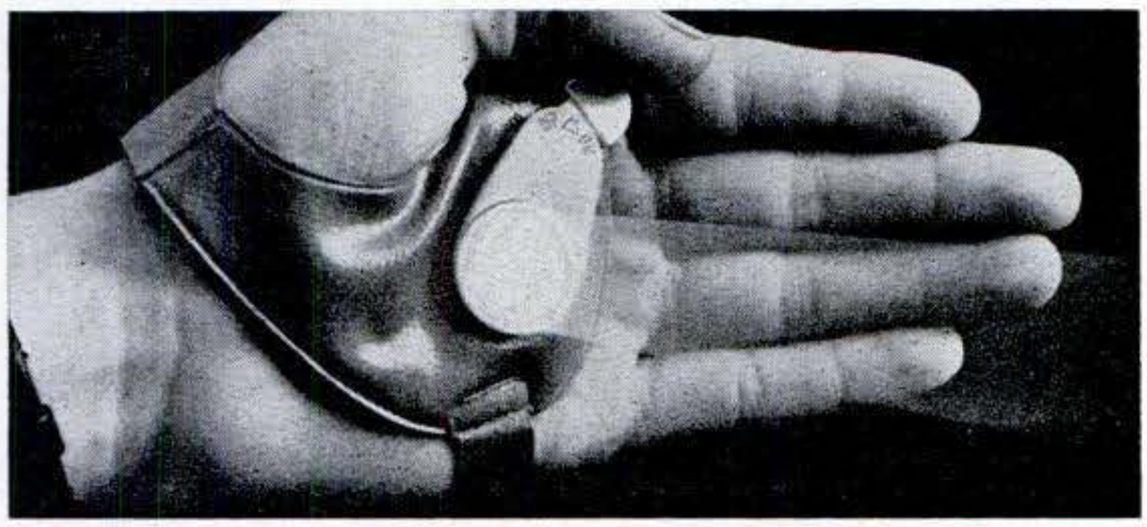
Sam goes where engineers fear to tread

Meet Sam—short for Self-propelled Anthropomorphic Manipulator. Developed jointly by NASA and the Atomic Energy Commission, Sam hails from a place called Jackass Flats, in Nevada. He works there, inspecting and making routine repairs on nuclear-rocket development and testing projects, controlled by engineers from a safe distance. He "sees" by means of a television camera (extreme top of photo), rolls to and from assignments on his own all-terrain vehicle, and gets most of his work done with his two mechanical arms.



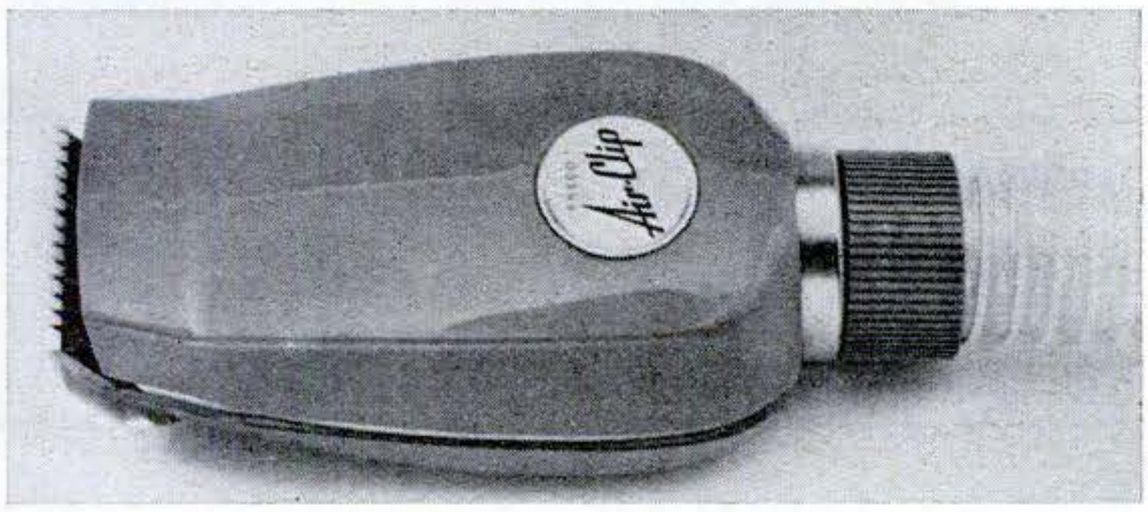
Snow dragster

Pegasus, the winged horse, is now Pegasus, the winged Skee-Horse—an experimental snowmobile out of Johnson Motors. The makers of the Skee-Horse line developed the long, low, and streamlined Pegasus as an exercise in snowmobile design.



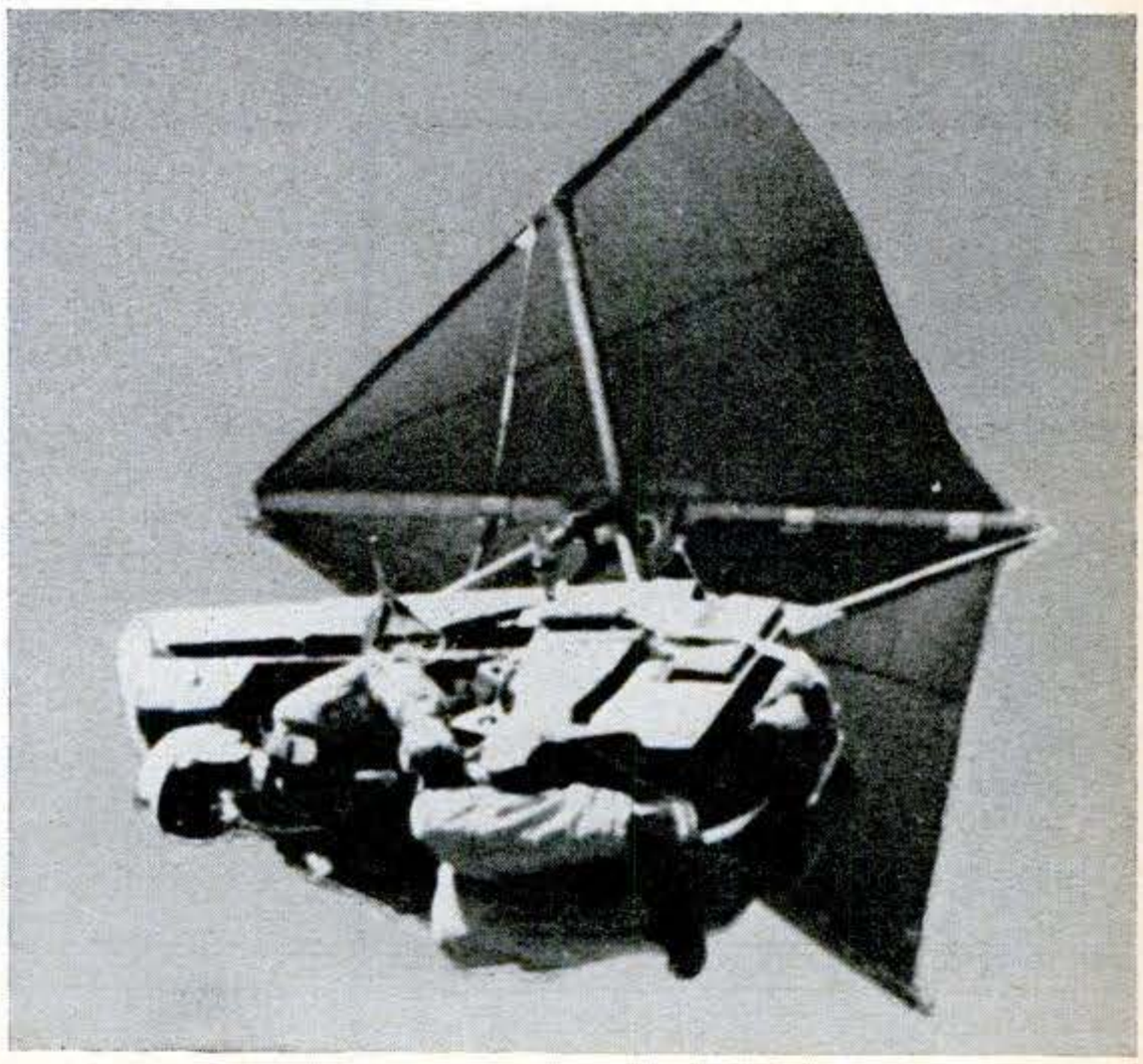
Handy light

With this lamp, Japanese mechanics can put light on the work while keeping their hands free. It straps to the palm, leaving fingers free to replace fuses or trouble-shoot under a dark hood. Two penlight cells in the strap provide the juice; a thumb switch turns it on and off.



Vacuum clippers

Air-Clip may bring haircuts back into style. Attach it to a vacuum cleaner—suction provides the power to run the blades, and picks up clippings, too. It's $19.95—with hose, cutting guides, and comb—from Cedar Hill Service, Foristell, Mo. 63348.



Flying seat

Pilot-ejection seats are getting pretty fancy. This Air Force one has a small turbojet engine and a parawing so the pilot can fly away from his disabled craft—as far as 50 miles—to avoid enemy ground forces. Once in the clear he pops a conventional parachute. That's a dummy in the photo.

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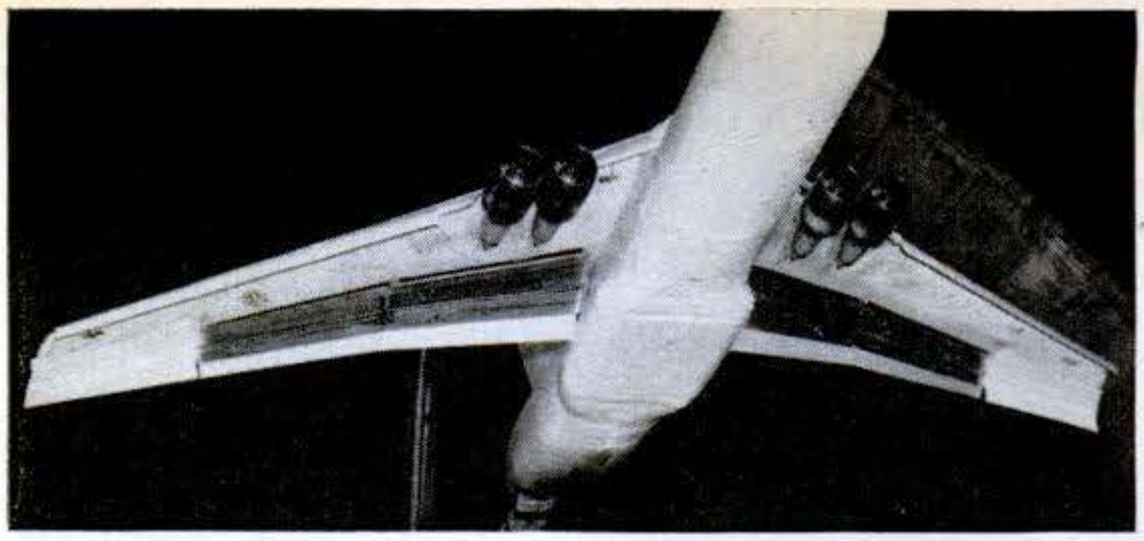
What's New

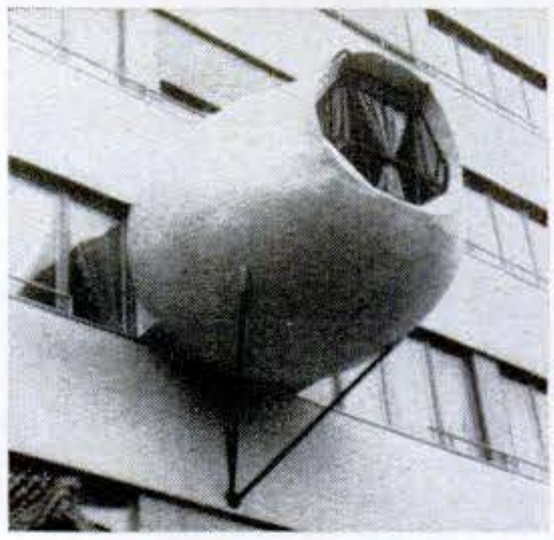
STOL power ➔

NASA is studying a new model STOL (Short-Take-Off-and-Landing) plane with engines positioned on the wing so their jet blast is directed against the wing flaps. Result? Conversion of part of the engine thrust to a lifting force, and reduction in the power needed to lift the aircraft from the runway.



➔ Ultimate toy: a low-down dragster

The man behind the wheel of this mini-machine is racer Mario Andretti. The man behind the machine's development is racer Mickey Thompson, who designed the mini-dragster to handle like a double-A fueler. It'll pop wheelies at a punch of the throttle, and stops just like the big boys—with spot disk brakes. Power is from a three-horse, four-cycle engine with recoil start, muffler, kill switch, and speed governor, driving through a chain-and-sprocket transmission. The machine weighs 150 lbs., is 113-in. long. $395 from Mickey Thompson Advance Engineering, Wilmington, Calif. 90744.

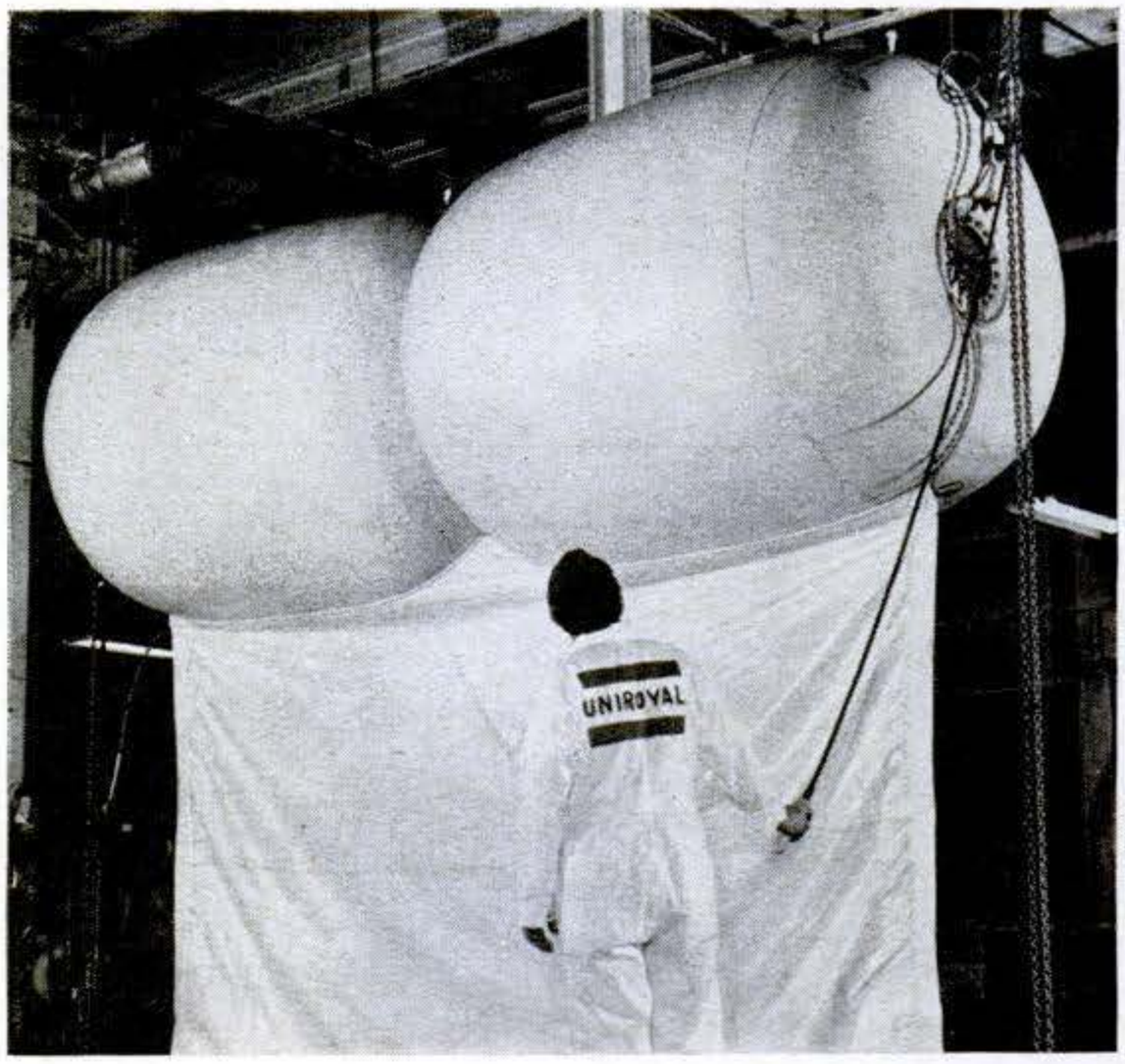


Plastic space maker ➔

Add a new wing to your apartment? That's what a resident of this Geneva, Switzerland, building did. He made it from plastic and suspended it from his window, beating the problem of finding a larger apartment in a crowded city. The 14-cubic-yard sphere weighs 661 pounds.

➔ Pinpointer

Signals from the Navy's Navigation Satellite System, picked up by this portable device made by Honeywell, are converted into precise information about the operator's location. The device can also be used by surveyors, and anyone else who wants to pinpoint his exact position on earth.



Slick stopper ➔

Five-foot-diameter hollow rubber sausages wearing eight-foot-long maxi-skirts of nylon are the key parts of Uniroyal's new device to battle spreading oil slicks. It's designed to contain oil spills in eight-foot seas, with winds as high as 30 knots. Anchors hold down the nylon skirts.

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What's New
IN HOME IMPROVEMENT

↑ Quiet can

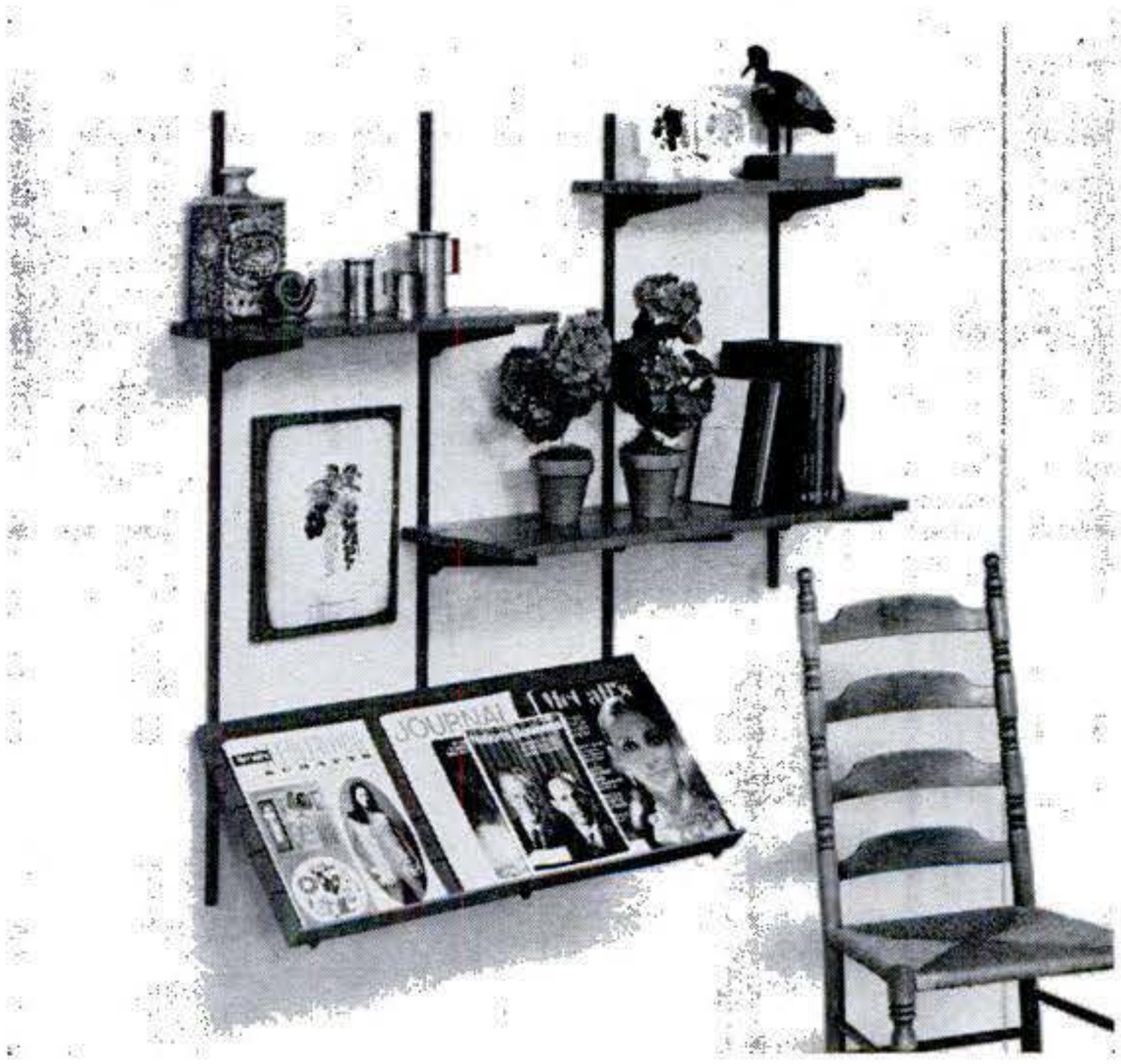
The noise-control engineer at Bethlehem Steel created this quiet garbage can by adding sound damping—rubber feet, mastic-coated bottom, belts riveted to walls and lid—to a standard can at areas of greatest vibrations. Dover Stamping Co. of Fall River, Mass., makes it—of steel, of course.

↑ Bowling-pin lamp

This 10-inch-tall desk lamp masquerades as a red-and-white bowling pin until you need a high-intensity light. Then the top splits off and pivots up on a bracket to form the eyeshade while the base flips to present an on-off, hi-lo switch. $6.95 from National Marketing Services, 219 Ninth St., San Francisco 94103.

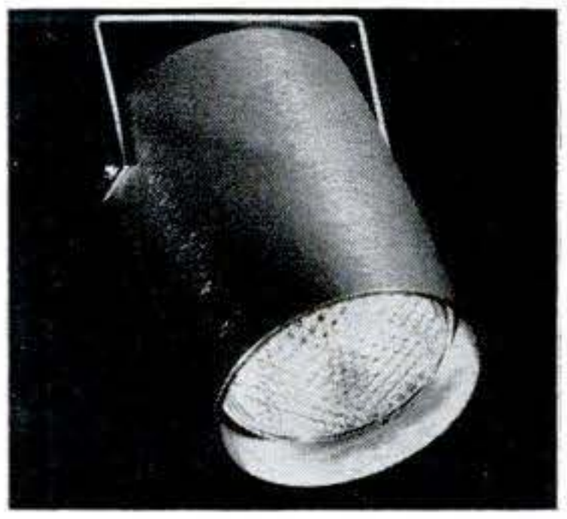
↑ Eye-level mini-oven for short orders

There's a full-size self-cleaning oven in the conventional place; the one up top is designed for preparation of quickie meals—frozen dinners, steaks, snacks. This Kenmore MXV electric range is one of 13 electrics and 14 gas models in the 1971 line that took Sears five years and $2 million to develop. Other features: a control to assure precise roasting time, easy-to-clean lift top, doubled fiberglass insulation plus airflow in the walls to assure cool operation. Prices run from $260 to $649 at Sears stores and catalog divisions.



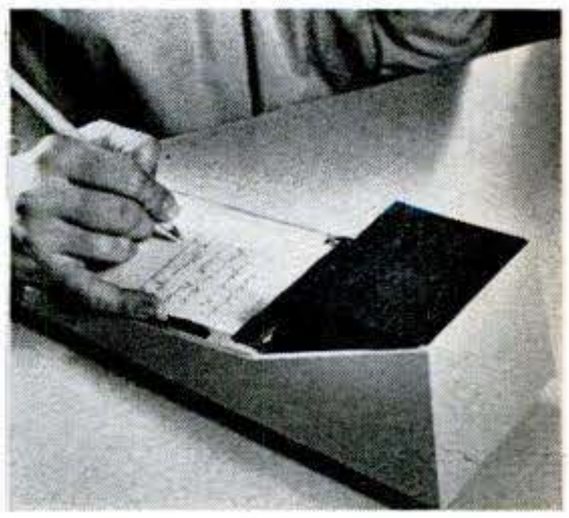
↑ Plank shelving

You can customize the depth as well as the length and staggered arrangement of your shelving with a new system from Kirsch. Shelves are made of 3-in. planks, so they can be six to 18 in. deep. Special pins lock planks, let you join them end to end, as well. Walnut, fruitwood, or green.



Little beacon ↑

This high-intensity sealed-beam floodlight is only 3⅛-in. long—ideal for use outdoors, or on boats, campers, or snowmobiles. Its satin-aluminum housing is in an adjustable stainless-steel mounting bracket. Models available for 12, 24, 48, or 115 volts. It's made by Bass Products, Box 901, Marblehead, Mass. 01945.

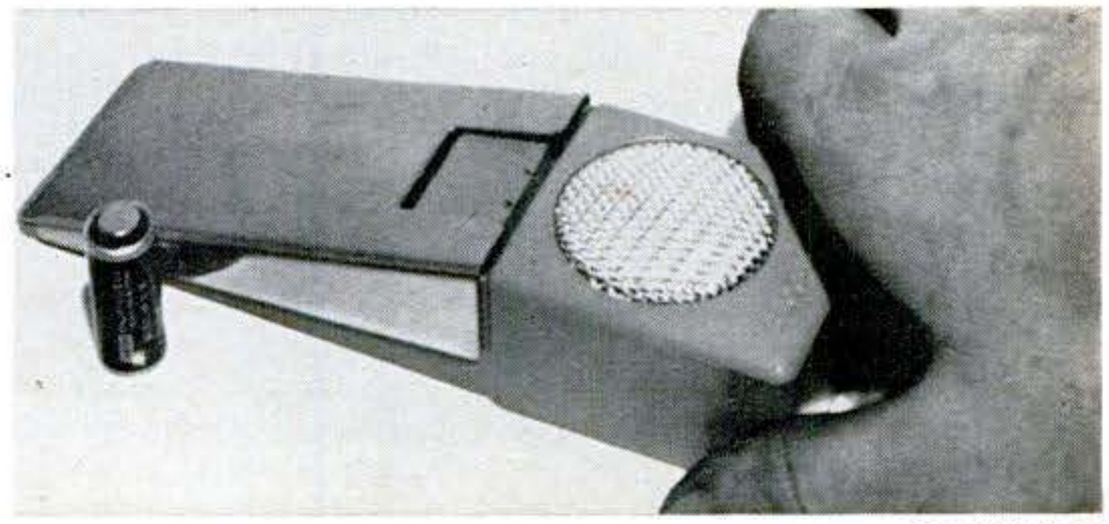


Powered pad ↑

If you take notes over the phone, you'll want the world's first electric roll memo pad. Touch the starter bar and the 3½-in.-wide paper glides out until you stop it. Powered by two C cells, the Memomatic is portable, costs $10. PAT Products, 465 Eagle Rock, Roseland, N.J. 07068.

Door-wedge alarm →

This pocketable burglar alarm is being sold in Britain for about $6. With tip inserted under a door, the wedge halts forced entry; its alarm sounds the instant pressure is applied. Audible for 80 feet, the alarm sounds until reset. It's powered by that 1½-volt Duracell battery at left in photo.



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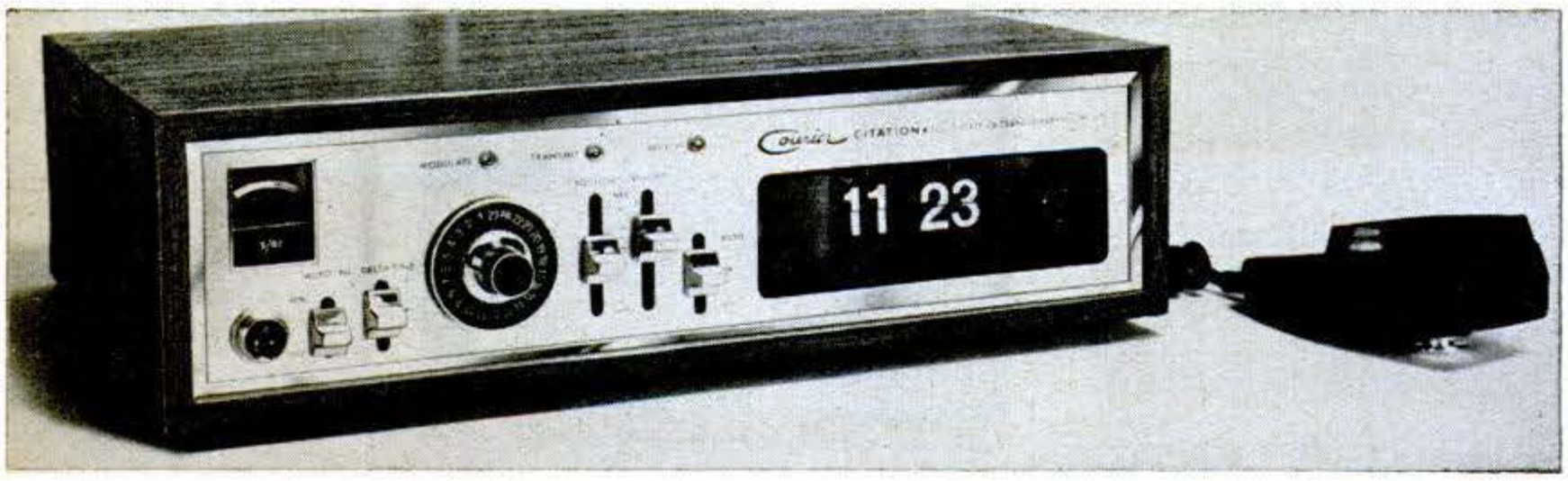
What's New
IN ELECTRONICS

Tuned-in cylinder →
Add still another shape to the wide range of AM table-model radios: Panasonic's cylindrical-styled Spinet. It's battery operated and uses a "roll-bar principle" for tuning. Other features: adjustable pedestal stand, ferrite-core antenna, earphone jack, choice of colors. Price is $19.95.

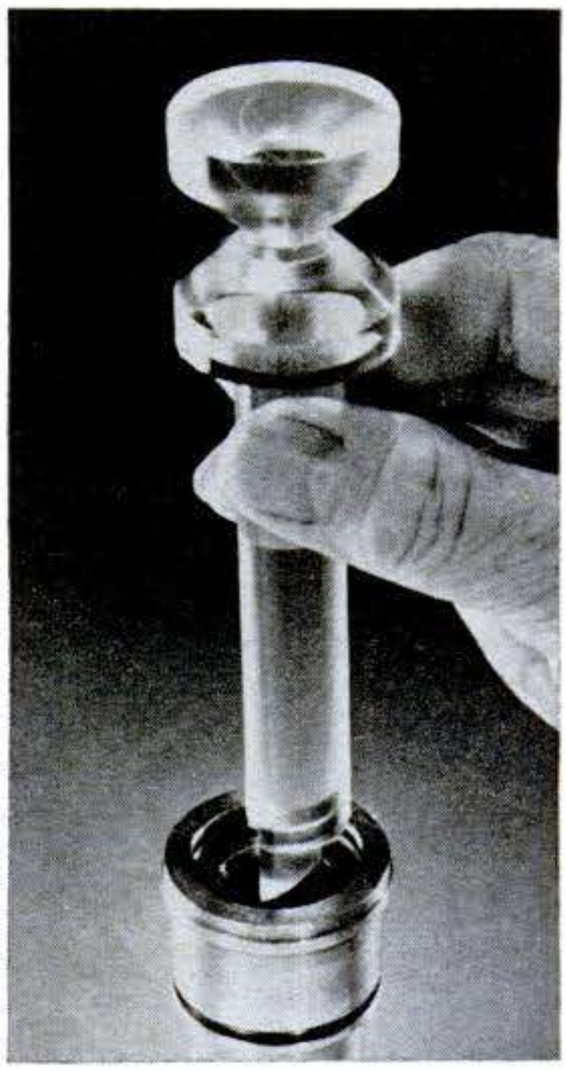
← For builders: 25-pedal solid-state organ
Here's a versatile new musical instrument you put together from a kit. Once you've built it, just flip a tab for 19 organ voices—15 manual and four pedal. This simulates the sound of a bass clarinet, English horn, violin, tibia, saxophone, and other instruments. Key lights of the Legato organ indicate notes and chords for easy playing. A two-speed Leslie speaker generates tremolo effects. Two 12-in. speakers in parallel run off the main amplifier; another amplifier drives the Leslie. A stereo headset jack lets you play "silently." The kit is $1,495 from Heathkit, Benton Harbor, Mich. 49022.



↑ CB with a timer
You can set the digital clock on this new base-station CB transceiver to turn on the unit automatically at any preselected time. Courier's Citation transceiver comes with crystals for all 23 CB channels. A special safety circuit prevents antenna mismatch and overload. It's priced at $229.95 from Courier Communications.

← Speedy repair kit
This all-purpose repair kit for electrical problems contains a wide selection of solderless terminals. You also get a tool that cuts and strips wire, crimps terminals, and shears bolts. Splices and ignition terminals are included in the 3-in.-by-8½-in. plastic case. American Pamcor, Valley Forge, Pa. 19481.

What's New
IN TOOLS



Light-pipe probe ↑
Made of crystal-clear acrylic, the Sight-Pipe's big head collects light and pipes it to the internal sidewall you want to check. Deep groove lets you use a penlight, if needed. In probe diameters from .25 to 1.75 in., depths up to eight times the diameter. From Dave Jones, 1023 S. Main St., South Bend, Ind. 46618.

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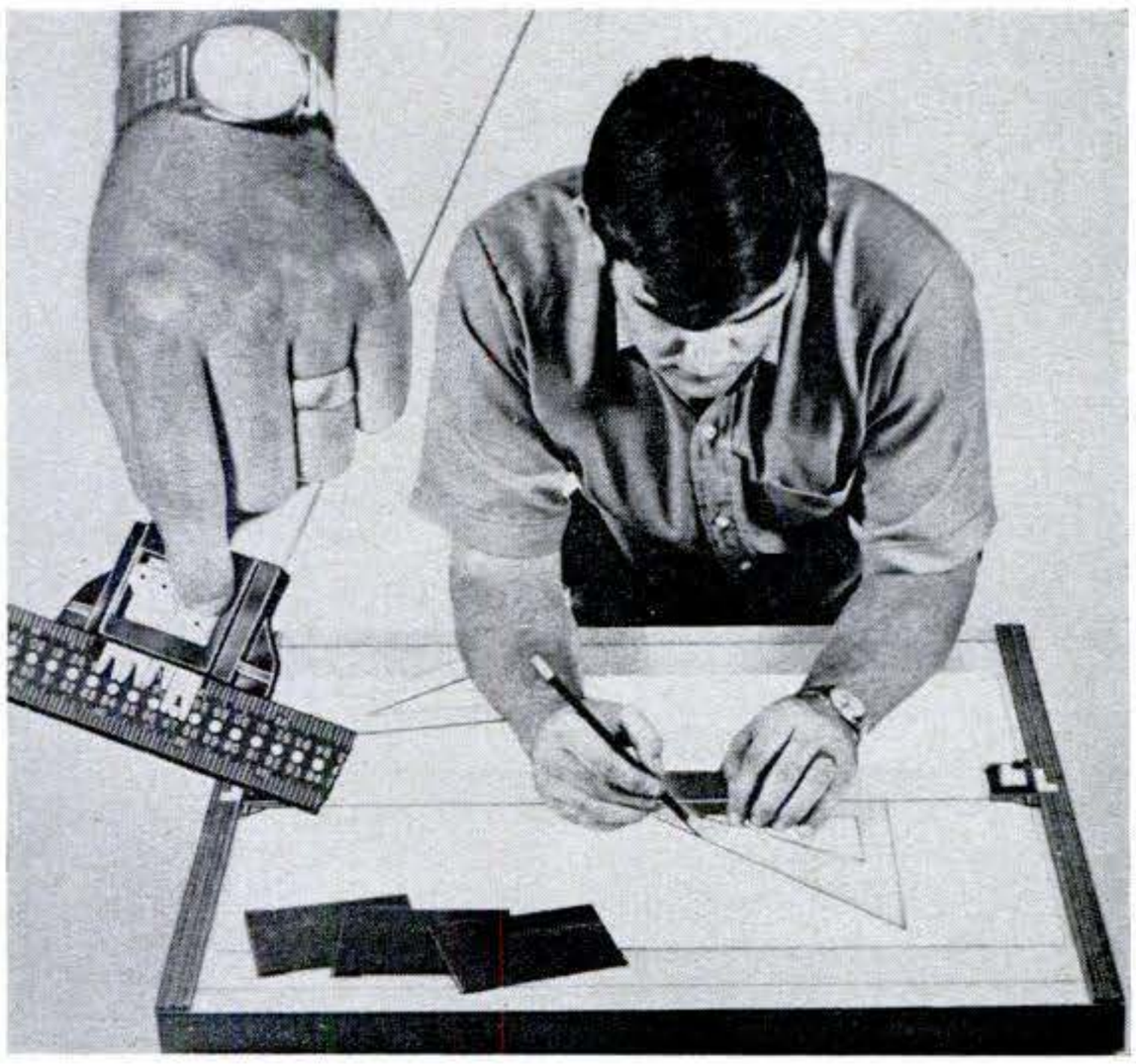
← Instant O rings
This splicing kit lets you make O rings on the spot—without the delay of searching for a replacement. You just trim the proper diameter of cord stock to a length that fits the O-ring groove or connection, then cement the ends. Loctite Corp., 705 N. Mountain Rd., Newington, Conn. 06111.

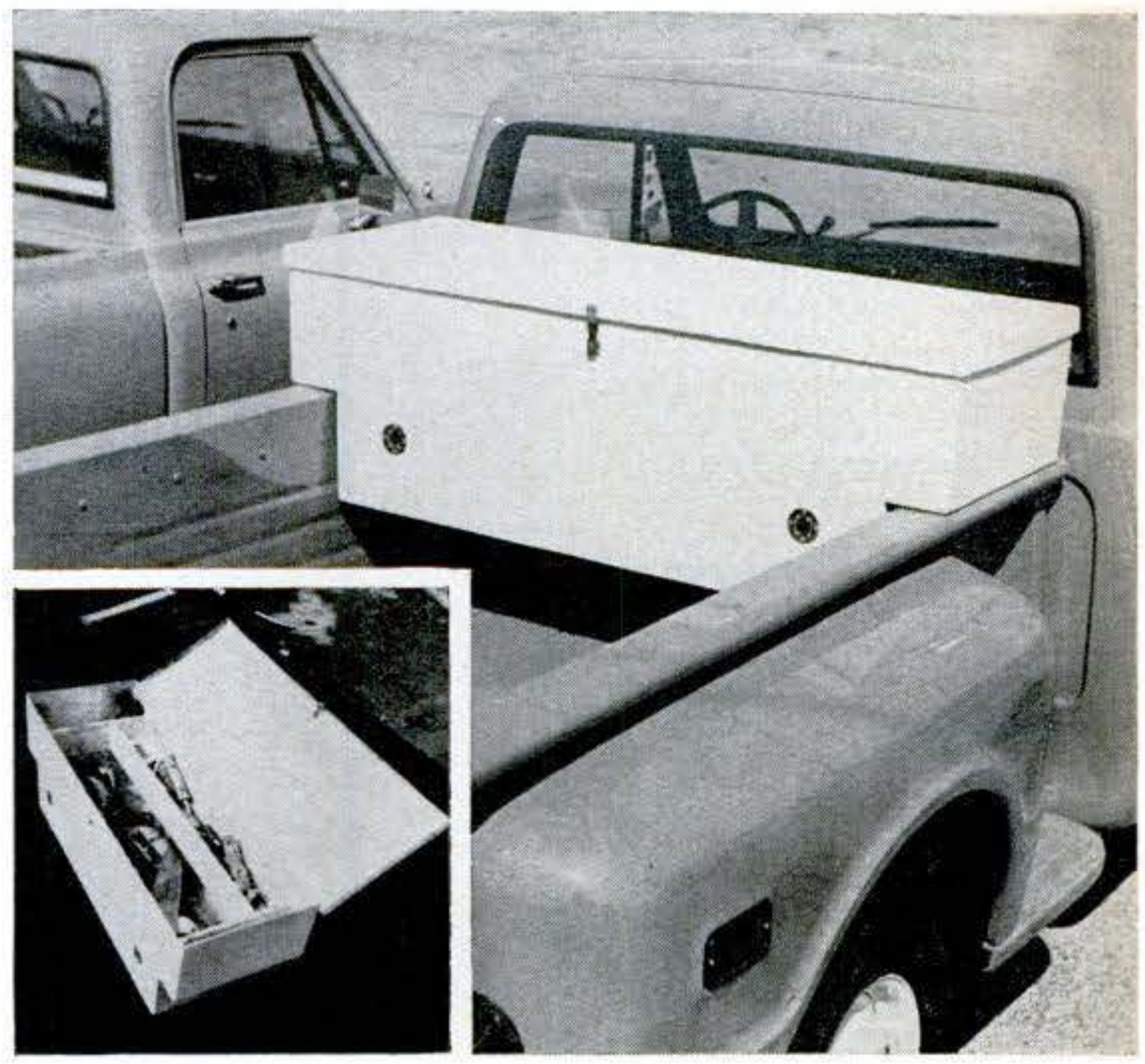
↑ Jigsaw kit
Everything you need for sawing is in Rockwell's $35 jigsaw kit: two-speed, double-insulated saw, assorted blades, rip and circle-cutting guides, and carrying case. The No. 68 saw features a cycloid cutting action for the fast splinter-free cuts usually associated with more expensive saws.



↑ Pushbutton system frees both hands for drawing
You can unroll this portable two-foot-square drawing system on any table or desk—it's easy for beginners, accurate enough for pros. Code simplifies fractional calculations, quickly locates any spaced measurement. Anchor snaps let you repeat steps, do art tricks, attach tracing patterns and stencils. Locking frees both hands, assures perfect parallel lines for charts and forms. Lexan J-Rules are mounted on tough Mylar drawing surface. Also included: foot rule, 60-degree triangle, and straightedge with adjustable T brackets. In tubular carrying case with instructions, the Traveler is $28.75 from Jig Rule Products, Bowie, Tex. 76230.

What's New
FOR YOUR CAR

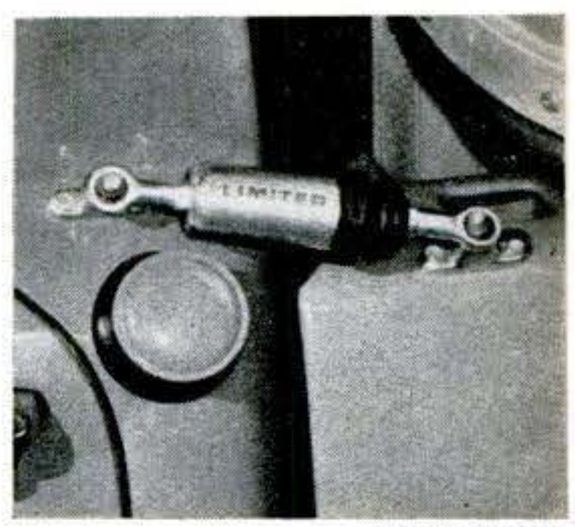
↓ Carry-all storage
This fiberglass truck box can hold ice-chilled beverages when it's not carrying tools and equipment. It'll hold tools for carpenters, mechanics, and plumbers, or equipment you want to carry to a hunting, fishing, or camping sight. Two sizes are available from Poseidon Corp., Box 374, Pell City, Ala. 35125.



Dash stay-awake light →
Installed on top of your dash, this light flashes every 20 seconds. If you're dozing, and fail to press a floorboard contact strip with your foot, a buzzer sounds. Still dozing? The Lifetimer shuts off the engine, flashes lights, and honks the horn. It's $130 from TIS Corp., 505 E. Eisenhower Dr., Loveland, Colo. 80537.

Highway kits →
Trouble on the road? This highway emergency kit offers a dry-chemical fire extinguisher, tire inflator and sealer, HELP flag, and two flares for $12.95. Less extinguisher and carrier (as here): $5.95. Mack's Ventimore Enterprises, 250 Denise Rd., Rochester, N.Y. 14612.

Truck stabilizer →
This pickup-truck stabilizer mounts horizontally between cab and box to take bounce and vibration out of your ride. It works with trucks that have a separate cab and box, or smooths out the ride in straight pickup trucks. Unicus, 842 N. Cummings Rd., Covina, Calif. 91722.



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What's New
FOR THE YARD

Bolt-together trac →

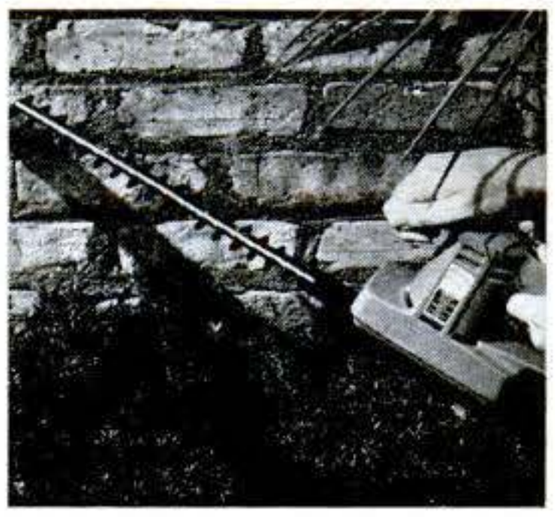
A few hours' work can save you some money if you're in the market for a garden tractor. You put this one together yourself from a $600 kit—and you're set to work in 12-horse, electric-start, four-speed style. It's from C. F. Struck, Cedarburg, Wis., who also offers a line of accessories.

← Easy cleanups

One way to bag those leaves you aren't allowed to burn is with a yard vacuum. This one, by Gilson, covers a 30-inch swath and works with an accessory hose for cleaning out window wells and getting under shrubs. Briggs & Stratton engines in 3½- and 5-horse models power the vacs.

↑ Charcoal-less grill

Use it on the patio or take it along when you go camping. Either way, the Big Boy 2701 LP-fired barbecue is right at home. The 18-inch brazier has a flame-level control, cast-iron burner, and rotating chrome-plated grill. Big Boy Mfg., 59 E. Orange Grove Ave., Burbank, Calif. 91503.



↑ Two-way winner

Double-edged for fast, easy cutting, double-insulated for safety—that's the new Wen 13-inch hedge trimmer. The half-horse electric motor delivers 1,200 cutting strokes per minute, mounts in a sturdy metal frame completely surrounded by tough plastic. The 5¼-pound trimmer is priced at $19.95.

↑ Ultimate water pistol

It's called the Six-Shooter because it takes six kinds of pellets—for washing, waxing, weeding, feeding, fertilizing, or killing bugs. Hook it to your garden hose and you're the fastest gun in the yard, switching sprays without even turning off the water. The W. D. Allen unit is $7 at stores.

What's New
IN BOATING

Seamless buoys →

What are little buoys made of? Foam-filled Cycolac ABS shells—at least those in the new line from Borg-Warner. They're low-cost, tough, seamless, and unsinkable; come in spar, nun, can, and anchor-marking designs; and can be fitted with lights.

Kit speedster →

She's a little over 17 feet long, with a V-bottom hull and a speed potential of over 60 mph. You build her yourself from plans or a frame kit, add your choice of engines and drives, and you're ready to go. The SK-type Thunderbolt is by Glen L, 9152 Rosecrans, Bellflower, Calif. 90706.

Tough scull ↑

Reinforced with exotic carbon-fiber/epoxy composites, this English sculling boat is reported to be stronger and cheaper than conventional wooden designs. The 45-pounder can be fitted with "training wheel" floats on the outriggers to help keep beginners riding right-side up.

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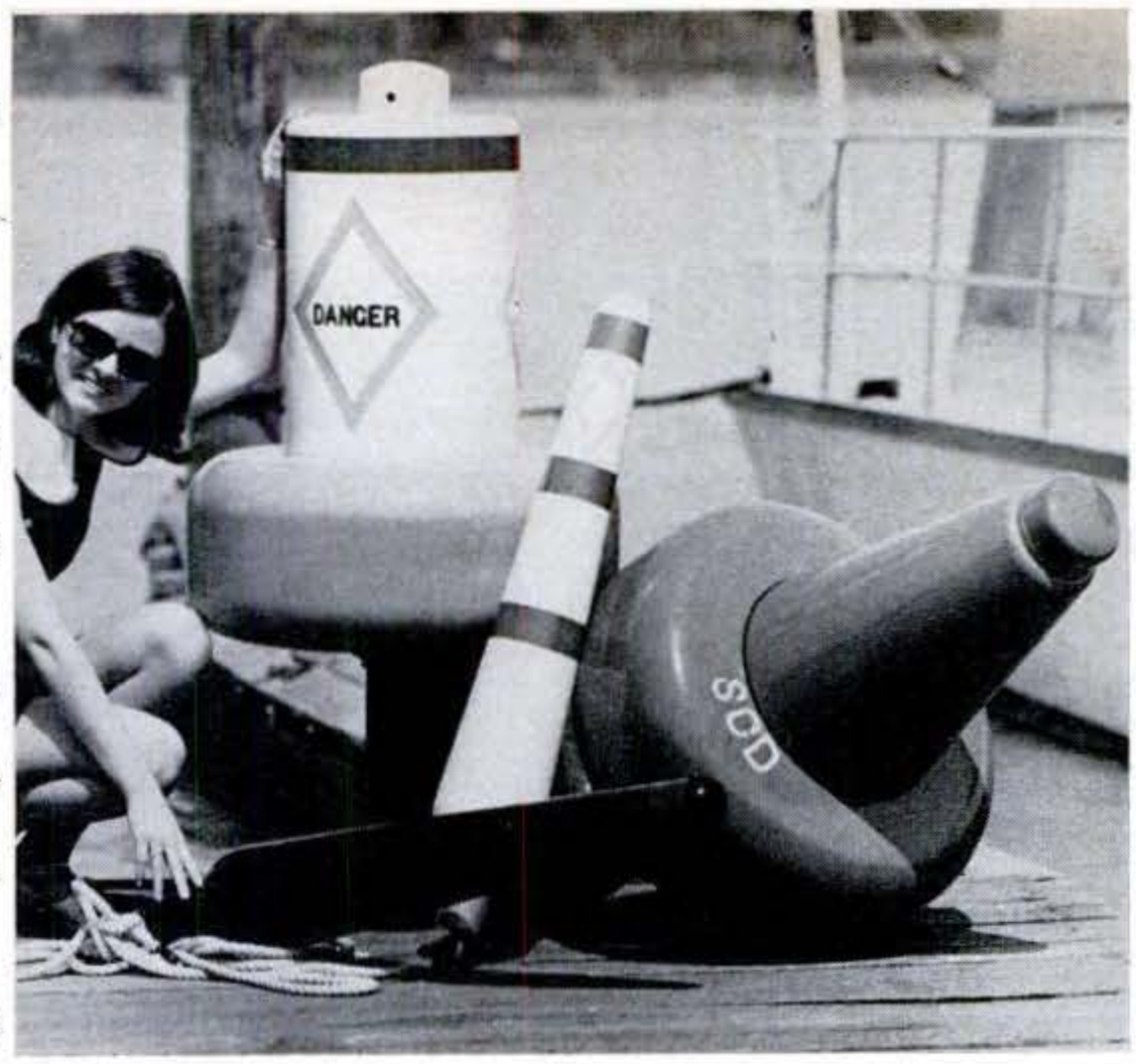
What's New
IN OUTDOOR RECREATION



↑ Fire fighter

Boat fires—electrical or liquid fuel—tend, ironically, to be "waterproof." That's why a dry-chemical extinguisher is a boater's most important accessory. This one, Model 275R by American LaFrance, uses a nontoxic powder discharged by air pressure, recharges without tools. It weighs 2¾ pounds.

↑ Cruise cooler

Planning a hot-weather cruise? The new Aqua-Therm water-cooled air conditioner may be the thing for you. The 110-volt AC unit has a 6,500-Btu output, enough to cool 120 square feet of cabin, sells for $399. Repco Products Corp., 7400 State Road, Philadelphia, Pa. 19136.

Instant tent camper →

Mounted to a special roof rack (top), it flips down in 15 seconds. Its rigid honeycomb floor is supported above the ground—and mud and bugs—by the luggage rack. On the car roof is a huge 6-by-6¾-foot bed with four-foot headroom. The Flipper camper is $495 from Montgomery Ward.

Free heat →

Heat water for your camper without burning gas or using electricity? Yup, a heat exchanger in the new Bowen GH6 water heater does it as you drive, using the hot coolant from your drive vehicle's radiator. In camp you can switch to gas operation. Atwood, 1400 Eddy Ave., Rockford, Ill. 61101.

Casting trap →

Here's an unusual way to fish. You cast this baited trap out into the water and it settles to the bottom, right-side up, and open. A quick pull on the hand line snaps it shut, and you haul in the catch. For non-sport fish, of course. Trick-Trap is $7.95 from Illi Enterprises, Box 2123, Ann Arbor, Mich. 48106.

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The Fine Art of Mating

Chevy Longhorn one-ton pickup truck and the Franklin 11½-foot, four-place camper make a safe, comfortable, carefully matched pair.

A complex task made simple: installing the right camper in the right truck—safely

By JERRY COPELAND

Most 10½- and 11-foot campers equipped with refrigerator, toilet, shower, and furnace, and carried on ¾-ton trucks will exceed the rated carrying weight of the truck by 500 to 1,000 pounds!

The rated gross vehicle weight (GVW) of the popular ¾-ton trucks is 7,500 pounds. GVW is the total weight a truck can carry, and includes the weight of the truck itself. Subtract truck weight from GVW and you get payload weight. The payload will include the camper and *everything* else carried—people and their gear.

Watch your weight. A well-equipped ¾-ton truck will weigh 4,400 pounds even without air conditioning. The minimum amount to figure for people and gear is 1,000 pounds. That leaves 2,100 pounds for the camper. Unfortunately, there aren't many fully equipped campers that light.

Almost as important as GVW is weight distribution. Safety and modern engineering dictate that the weight be spread so that each axle carries its share of the load. Ideally, the front should have 40 percent of the GVW, the rear 60 percent. But with the large overhang behind the truck's rear wheels, few rigs attain this 40-60 ratio. Past practice has shown that 35-65 ratio will perform reasonably well. These figures apply at the rated GVW and are more difficult to obtain as GVW is exceeded.

Trucks are designed to carry three to five percent of payload on the front wheels, 95 to 97 percent on the rear. For every 100 pounds added, 95 pounds are carried on rear wheels. This is where you get into trouble exceeding rated capacities.

What should the prospective owner do? Follow us as we report how we selected a compatible pair.

Camper first. Contrary to popular belief and present buying habits, the *camper* should be selected *first*, not the truck. We chose a Franklin 11½ foot FK. This designation means that it is 11½ feet long and has a front kitchen. The floor plan is very important from a standpoint of weight distribution. The heaviest appliances and gear should be stored as near the front as possible.

The manufacturer told us this particular camper would weigh about 2,750 pounds. We checked the figures in certified scales. The maker was close—the camper weighed in at 2,770. Adding 1,000 pounds for people and gear, that put our payload at about 3,800 pounds.

Then the truck. Chevrolet has a one-ton pickup in their Longhorn series with a GVW rating of 9,000 pounds and wheelbase of 133 inches. This capacity gave us plenty of leeway for our 3,800-pound payload. Options are almost completely preselected by Chevrolet as mandatory with the prescribed GVW. Springs are 1,750 pounds front and 4,150 rear, with auxiliary. All springs are leaf type. Recommended engine for this package is the 400 CID V8, and standard rear end has a 4.10 ratio.

Tires are the wide-based, low-profile type sometimes called flotation tires. They have several advantages over the older split-rim types. The wide tread gives greater side-to-side stability and the ride is much softer. Since these tires put more rubber on the pavement, they increase braking power, too. We have eight-ply on the front and 10-ply on the rear and spare. This gives us a carrying capacity of 3,170 pounds on each rear wheel at 75 psi and 2,780 pounds on each front wheel at 60 psi.

For comfort and appearance, we

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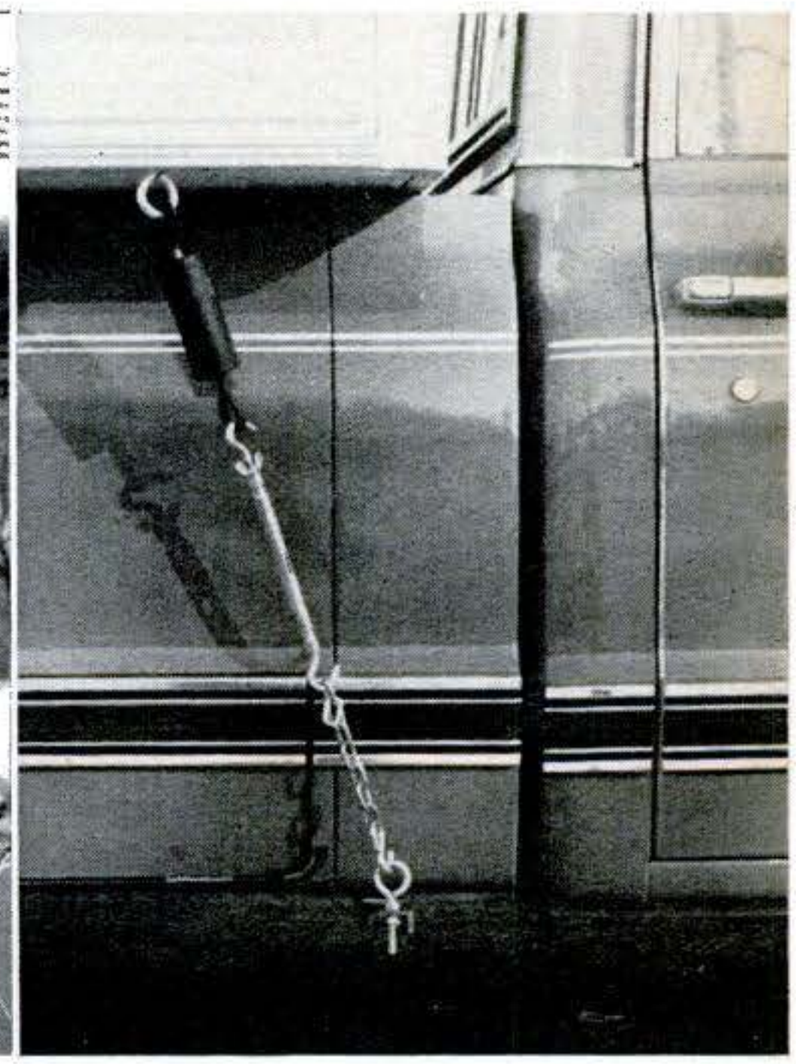
a Camper and Pickup

Aluminum step bumper offers lightweight protection for camper's rear, simplifies entry and exit. This one's by Silver Top.

Front shock absorbers under camper overhang eliminate freeway hop at high speeds. Attach to pickup cowl as described in text.



Buffer spring (dark cylinder) is used to permit give under stress. To achieve adequate tension, twist the turnbuckle.

chose the Cheyenne cab, air conditioning, and Turbo HydraMatic transmission. Auxiliary battery, camper wiring harness, and tool storage box should be included for camper service. Power steering is also a must on a rig as large and heavy as this, and of course we need the full set of gauges and camper mirrors.

Hold-downs. The next problem was the best method of holding the camper to the truck. Many types of hold-down brackets are available, but we rejected any method that fastens to the pickup box. Fastening to the truck frame is the only secure method. This can be done in several ways.

Our favorite method uses "outriggers." We know of no accessory manufacturer that offers these, so we had them made locally. We purchased 12 feet of two-inch steel channel from a local steel company and took it to a welder with a diagram of how we wanted them made.

The brackets are bolted on the vertical side of the truck frame. The front end of the frame has holes that will accommodate the bolts when matching holes are drilled in the brackets. But the holes in the frame are ⅜-inch, so we enlarged them with an electric drill to take ½-inch bolts. Holes had to be drilled into the rear frame to mount the other pair. Cost of material, cutting, welding, paint, eyebolts, chain, and turnbuckles ran just under $25.

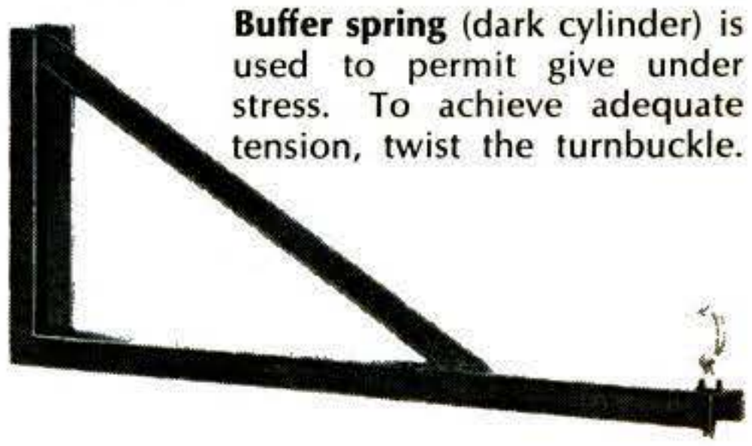
The selection of turnbuckles is important, and after much searching, we found the steel ones we wanted. A wing nut is installed at the right-hand thread end to lock it in place. With everything in place and tightened, the camper is held on securely.

As a precaution against being too rigid, we added a pipe with a large coil spring (200 pounds per inch) inside. One end is fastened to the pipe. The shaft of an eyebolt passes through the center of the spring and fastens to the other end with a washer and nut. In a high-strain situation, these buffer springs compress. In some instances there is a possibility that a rigid mount without buffers could affect truck steering.

Adding accessories. A step bumper is desirable for protection of the rear end of the camper and for convenience in getting in and out. We installed a 10-inch, 50-pound all-aluminum bumper made by Silver Top Manufacturing of White Marsh, Md. The low weight factor can be important because the entire assembly is suspended from the rear of the truck.

When the camper was all loaded up and fastened down, we filled the water tanks, LP gas tanks, and the gasoline tank. Next came clothing, dishes, bedding, and personal gear. Total weight now, including two adults, was 8,740 pounds—250 pounds below our truck's GVW rating. Front

[Continued on page 132]



Hold-down brackets fasten to truck frame, provide anchor for turnbuckles. Never fasten rig to truck body or bed.

Intercom system allows easy communication between the truck cab and camper. This under-the-dash unit is from Phillips.

TEST RESULTS

Acceleration 0-60 mph	18 sec.
Acceleration 0-80 mph	39 sec.
Acceleration 25-70 mph	24.75 sec.
Braking distance 60-0	148 feet
Total miles traveled	1,276
Fuel consumed	143.5 gal.
Average fuel mileage	8.8 mpg
Truck weight	4,910 lbs.
Camper weight—dry	2,770 lbs.
Total weight—camper, truck, people and gear	8,740 lbs.
Front axle weight	3,260 lbs.
Rear axle weight	5,480 lbs.
Weight distribution ratio	37.3—62.7

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The four-wheel-drive Bronco makes an ideal vehicle for towing a camper off the road and into the desert, where you can get away from the crowded parks.

An 8,000-pound-capacity winch, like this one shown pulling a pickup camper up a rugged slope, makes a handy option for a four-wheel-drive vehicle. This electric winch is powered by the truck battery.

- **What's a PTO?**
- **What are free-wheeling hubs?**
- **What does "four high" mean?**
- **Who needs 4WD, anyway?**

What You Need to Know Before

Undercarriage of the Bronco reveals the additional driving axle and details of front suspension and steering linkage. Wide tires like these are popular for 4WD use.

By BARRY LOPEZ

For most of us, shopping for a four-wheel-drive vehicle is a brand-new experience with brand-new problems. Understandably, many potential buyers arrive at the dealer's lot at a slight disadvantage.

Do you really need a four-wheel drive, or can you get by on two? What's PTO mean? What's the difference between high range and low range? Sometimes even the salesmen don't know the answers.

To eliminate some of the confusion, let's take a look at what sets the four-wheel drive apart:

Do you need one? On the average, if you have one, you will drive one mile in four-wheel drive for every 28 miles you drive in two-wheel drive. You need 4WD for bad traction situations, particularly in mud, snow, and sand. If the ground is dry and not too steep, you can usually get by with a two-wheel-drive vehicle.

Think of four-wheel drive as a very expensive option in what, for most people, will be a second car. Like trucks, however, 4WDs hold their re-

A Chevrolet Blazer rolls through snow, where four-wheel drive can be a man's best friend, heaping on extra traction. But it's also handy to have 4WD for driving through sandy or muddy terrain.

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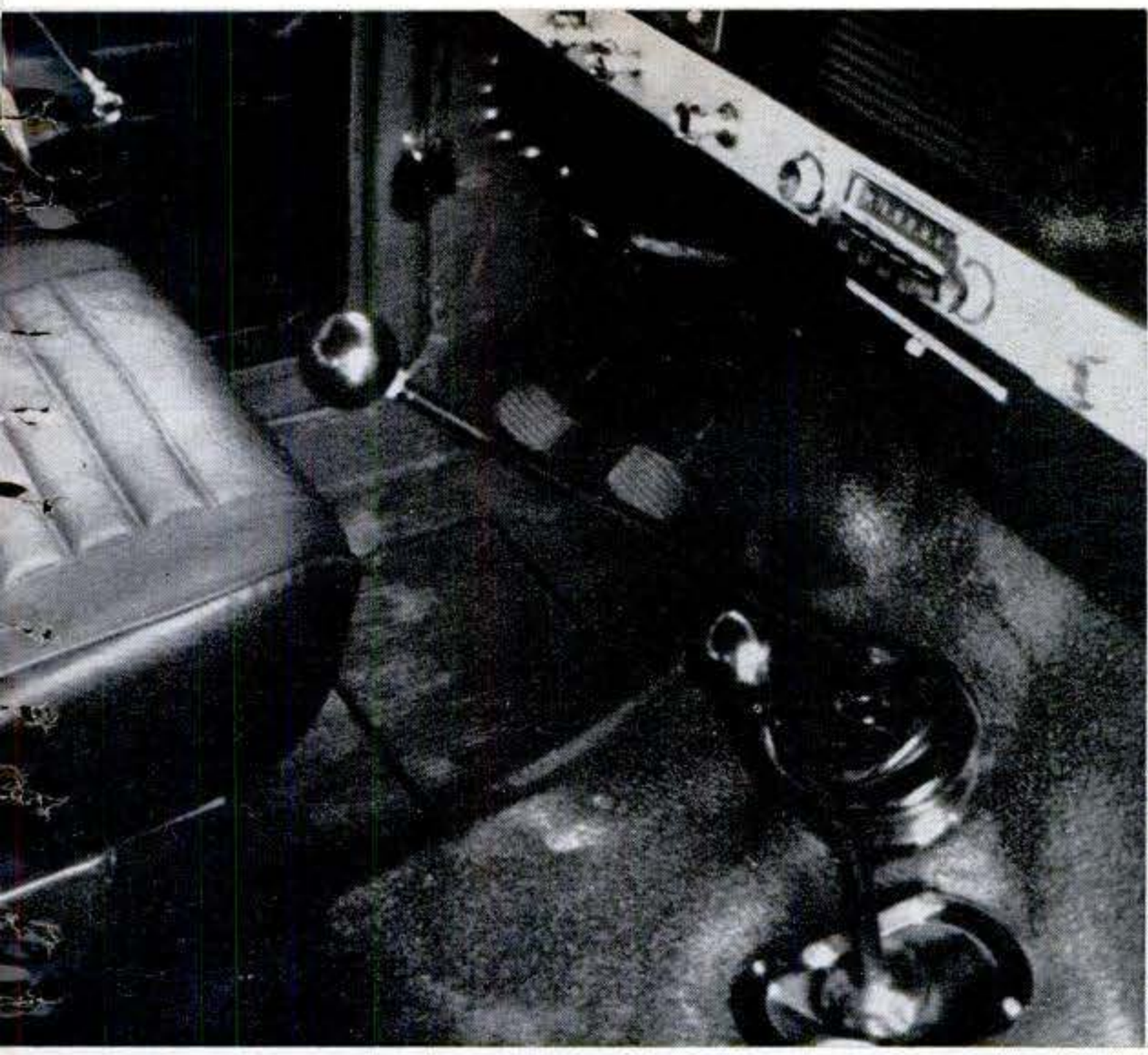

A four-wheel-drive transfer-case lever (in foreground) shifts the International Scout into all-wheel-drive mode when you also lock the front wheel hubs (photo above at right).

Locking of front wheel hubs is accomplished with a twist of a dial on the hub. The hubs must be unlocked when you shift back to two-wheel drive to reduce wear and tear in the drive train.

You Buy 4-Wheel Drive

sale value longer. Still interested? Then there are a few other things you should know about:

Free-wheeling hubs. Also called selective drive hubs, or "Warn" hubs, they permit the driver to "unlock" or disengage his front wheels from the drive train when he goes into two-wheel drive. The front wheels then free-wheel. If they remain locked in while you're in two-wheel drive, they turn the shafts and gears in the idle front-drive train, causing greater wear and tear in the drive train, especially on universal joints.

Free-wheeling hubs have two positions—"lock" and "free"—and are usually hand-operated with a dial at the hub of each wheel. Some are automatic. Because they reduce the work load on your engine, they usually increase gas mileage. They also make for a smoother, quieter ride and reduce wear on the front drive train.

Need a winch? If you're in a bad spot where you can't get any traction, or you're on a hill that's too steep to drive up, a winch is a lifesaver. Or, with your vehicle anchored, you can also use one to pull another rig out of trouble, pull downed timber off a road, stretch fence wire, or hoist loads.

There are two popular types, mechanical and electric. Mechanical winches operate off your engine via a drive shaft; electric winches draw power from your battery. Valid arguments can be made for either one. The electric winches, more popular, are less expensive to install and are sometimes easier to operate. Their most obvious advantage is an ability to operate independently of the engine, which can then be shut off (say, in crossing a river) or be used to assist the winch's pull with a push through the wheels.

What kind of tires? Chances are your four-wheel-drive rig will come with tubeless, four-ply-rated tires with some sort of mud/snow tread. They are usually adequate, but if you're going to spend a lot of time in the back country, give serious thought to tube tires, which you can repair yourself, and to a higher ply rating. Bear in mind, too, that the more cleated the tire is, the more vibration it will transmit and the more noise it will make on the highway.

Wide-tread tires have become very popular because their greater surface contact means better traction and support. They're great for driving over loose sand and such, but all that rubber makes the vehicle harder to steer at low speeds. And wide treads also tend to hydroplane more on wet pavement at high speed.

Narrow tires that slide off smooth rocks and slip around on hard, rutted roads can tear the steering wheel right out of your hands. Wide tires are an advantage here—and so is a steering linkage damper that will absorb that shock.

The engines. Usually you have a choice between a straight six and a V8. The V8 offers plenty of horsepower for pulling heavy loads and for high-speed cruising, but don't overlook that six. It has higher torque at low rpm and is, of course, more economical to operate.

You're less apt to spin the wheels and dig yourself in with a six, too, because you get close to maximum torque at such a low rpm. A six will also give you close to 14 mpg while gas mileages of 10 and 11 are not unusual with a V8 in a 4WD.

Protective equipment. Since you're often in rocky country on badly rutted roads with a 4WD, you stand a

[Continued on page 137]

A 4WD with an eight is what you need if you want to haul a heavy trailer as this Jeep Wagoneer is doing. A six-cylinder, however, is more economical on gas.

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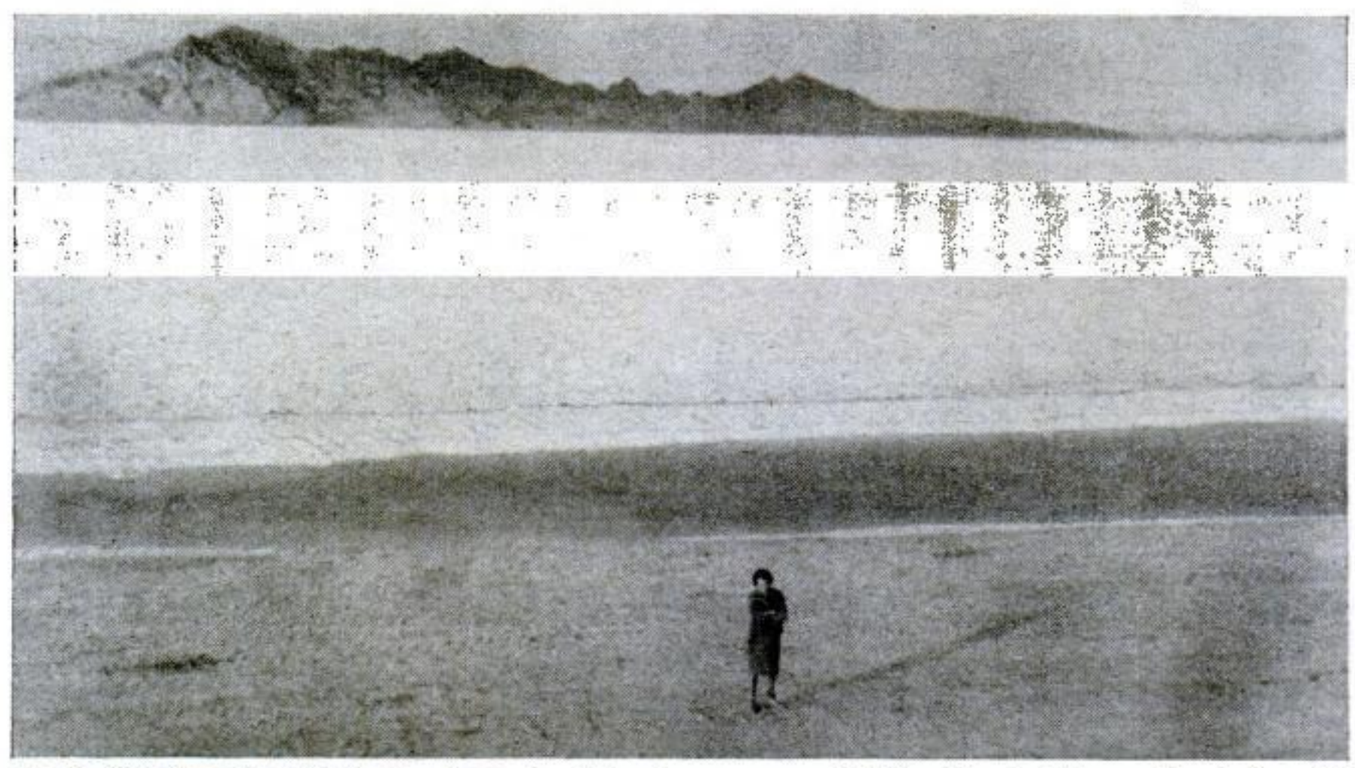
Much of I-80 is monitored on CB's channel 9. An emergency call evokes an instantaneous response.

Sylvan dells for camping abound on I-80 in the west, and in the east inveterate campers weekend in their trailers on private grounds from spring to fall.

ALL THE WAY ACROSS THE COUNTRY BY CAMPER ON INTERSTATE 80 — OR NEARLY SO

Iowa's quaint Amana colonies, dating from 1854, have converted from socialism to profitable capitalism.



Rock fill five to 10 feet deep had to be poured into the I-80 roadbed for 30 miles west of Salt Lake City because rain would leach out the salt on the Flats.

I drove our first coast-to-coast interstate—

THE CAMPERS' EXPRESSWAY

A PS reporter travels the colossal Interstate 80 from Atlantic to Pacific—and back—and finds it to be a boon for campers who like long, fast trips

By DEVON FRANCIS

From the northeast seaboard to mid-northern California—across the Alleghenies, the Great Plains, the Rockies, the Intermountain West, the Sierras, and the lush coastal valleys —there now stretches a great, scenic transcontinental superhighway and the longest single traffic artery in the projected 42,500-mile Interstate Highway System.

This is Interstate 80, now nearly complete, and for much of its length a camper's and sightseer's paradise.

Last fall I drove I-80 coast to coast, west and east, with a camper in tow to bring you a report on:

- The campgrounds.
- Where to go, what to see.
- The route—and the detours.
- Tips on saving money.

I made the trip with my wife Rosemary and our poodle. Our trailer, a Starcraft Six, was complete, with a propane/electric refrigerator and a space heater. Reports of early snows on the route led us to consider sewing ourselves into thermal underwear, but we settled for sleeping bags for the chill of higher altitudes.

Our car was equipped with a Messenger III citizen-band radio (made by E. F. Johnson Co., Waseca, Minn.) that covered four frequencies besides emergency channel 9. It was a real comfort to have a C-B radio available to call for help if we needed it, because there are plenty of long stretches without facilities that we had to travel. And a call on channel 9 could bring us instant help in any emergency.

Campsites abound. We had no trouble locating places to camp near I-80 (by law there are no facilities on the toll-free portions of the highway itself). Counting only those camping sites within reasonably easy access from I-80, there are 440, coast to

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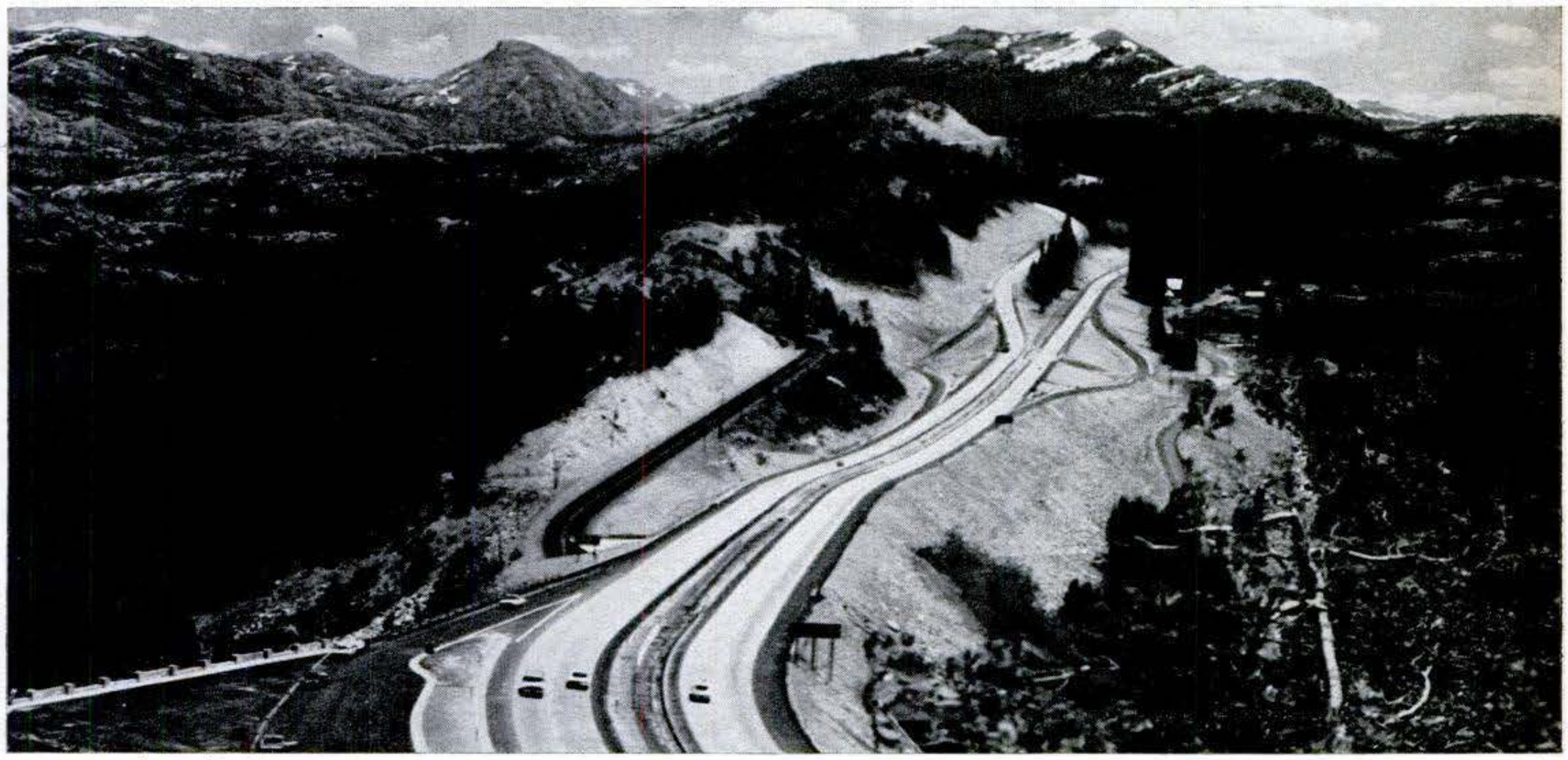
Our Starcraft camper provided everything including a space heater for those nippy nights in the mountains.

The right-of-way had to be displaced considerably between Fernley and Lovelock in Nevada—steam from hot springs wrecked the asphalt.



Cutting majestically through the mountains at Emigrant Gap on the western slope of the Sierra-Nevada mountain range, Interstate 80 takes you through one of the most scenic points in the western U.S. That's the turnoff for Vista Point you see at lower left.

coast (see chart). Our count of the public grounds was 192; of those privately run, 248.

All the public grounds are for camping in the literal sense. They are vacation spots. What matter if many lack flush toilets and showers?

Private grounds range from super-duper layouts with swimming pools and riding horses, through commercial camps accommodating everything, even house trailers, to the genuine article set among trees and babbling brooks. Standard commercial camps offer such comforts as home laundries and hair dryers.

Take your choice on I-80. Exit signs marked "Camping" abound.

The things to see. New Jersey and Pennsylvania crawl with Revolutionary War history. Try northern Ohio at maple-sugar time. See the Indiana sand dunes. If you're a whodunit addict, like us, stop off for a look at Illinois' Starved Rock State Park, the scene of a multiple murder a decade ago. See Iowa's Amana Colonies. Wander through Nebraska's Cow Town.

As natives of the Great Plains who long have gone jelly at mere mention of the West, we hit our stride in Wyoming. There's Yellowstone, and Jackson Hole, and the Grand Tetons. And if the bizarre scenery far off I-80 to the south in Utah doesn't stop your heart, see a doctor. We love Nevada, even though Virginia City has gone honky tonk.

Stop at the Sierra pass where, on Oct 29, 1846, the Donner party got mired down in 22 feet of snow—42 persons out of 90 perished. Tour California's Monterey Peninsula. We stood in the midst of the great redwoods at the Big Sur—probably the nation's most impressive campground—not minding the rain.

Traveling the route. For those who shudder at opposing traffic while doing 65 on the old, two-lane, serpentine routes that I-80 supersedes, this trip is balm for the nerves. Where I-80 is complete, it is four-laned, and for the thickest traffic around cities this jumps to six, eight, even 10.

Allowable speeds range from 60 (if you're not trailering) to any speed that seems reasonable. Anyone who really wants to mash the throttle can halve the time it used to take to cross this band of the U.S. Today's actual

[Continued on page 128]

Trail Camping: New Gear Makes the Simple Life Simpler

The boom in backpacking widens your pick of gear to smooth the edges of "roughing it"

By AL LEES

Simple gear can extend vacation fun. Above, author locks his RV at end of Kings Canyon road for impulsive overnight hike into the High Sierra. Standard sleeping bag used in camper was belted to inexpensive backpack that holds Sterno stove, freeze-dried foods, air mattress. For longer trips, look at the trail bags below.

Sure, RVs are great—but if you're a wilderness type, wheels get you only halfway there. And if you're like me, trailbikes aren't the answer for the rest of the distance (they're banned from most National Park trails, anyway). There comes a time to park at the end of the road and take off uptrail, with all your provisions on your back. And if you've never tried it, I recommend it for this summer, before the growing popularity of trail camping overcrowds the wilds.

It's best for a beginner not to try the wilderness trails alone, but such a hike adds an ideal "extra" for a couple or family on vacation. And it's easy to test your gear—and your stamina—on weekend trails near home. To outfit yourselves, you can spend as little or as much as

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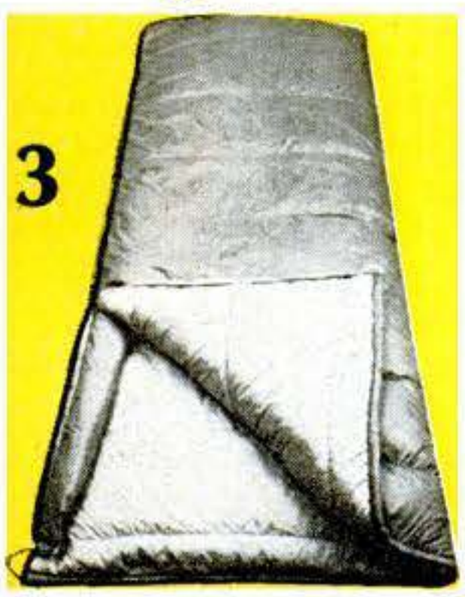
SLEEPING BAGS



Lightweight bags ease your load. (1) L. L. Bean goose-down trail model with double-quilted nylon cover, cotton lining, 5 lbs. 6 oz., $64.75. (2) Also Bean, but filled with Jen-Cel-Lite fleece wool and polyester, 6 lbs., $33.75. (3 and 4) Coleman goose-down bags: No. 551 has semitapered nylon cover and lining, 4 lbs. Mummy 600, 5 lbs., is snug to –20°

COOKING GEAR

Weekend's provisions, grouped around author's Sterno stove (1), include dehydrated beef stew, chicken-and-rice, freeze-dried vegetables, instant juices—all from Stow-A-Way, as are stoves (2) Bleuet butane, $9.75, and (4) Heat-Pal alcohol, $26.95 —really a heater, but it also serves as a one-burner. (3) See text.

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BACKPACKS

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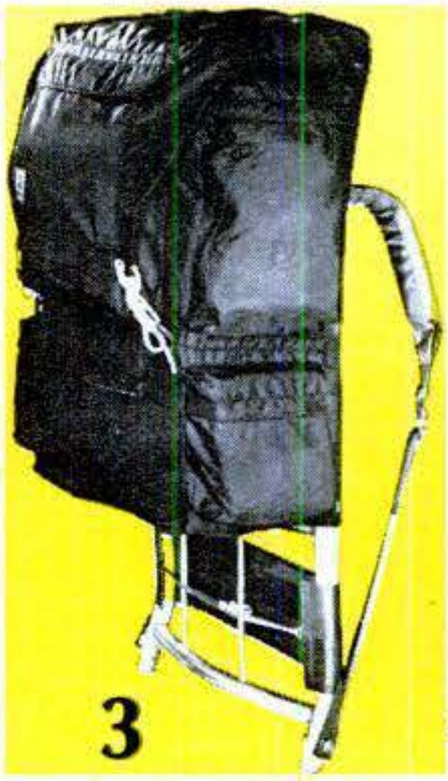
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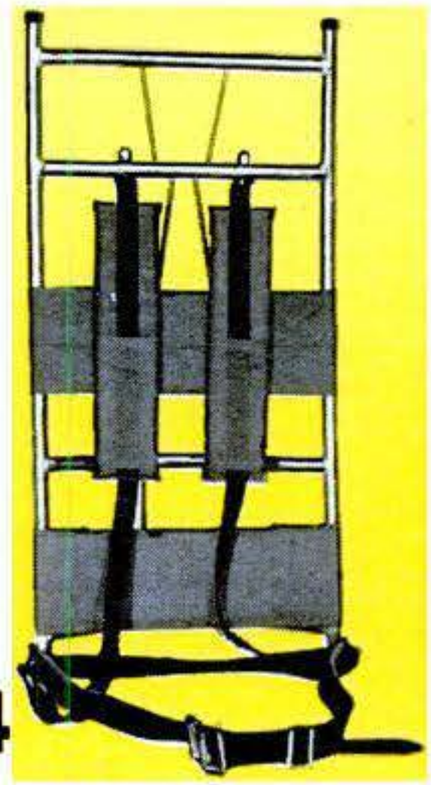
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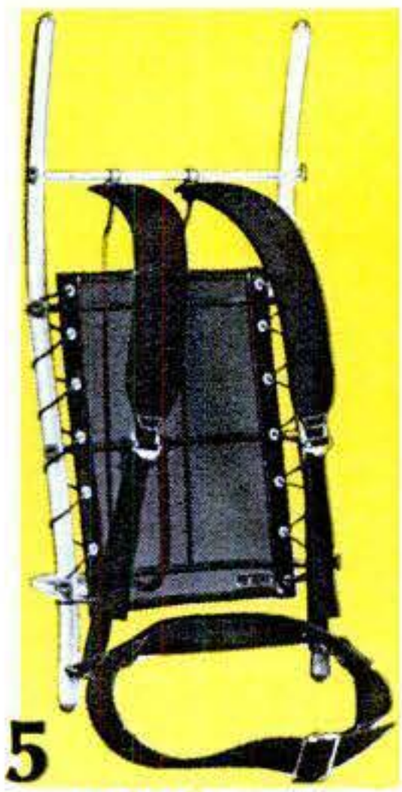
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Choose your pack to fit its use. Prices vary with quality. In general, the more you pay, the easier your burden. (1) Coleman standard frame, $18, and sack, $12, total 3½ lbs. (2) Coleman frameless day pack, 12 oz. (3) Bean's Cruiser frame, $12.75, and waterproof nylon bag, $25.40. (4) Moor & Mountain frame, $22; note extra top crossbar, waist strap to stabilize load. (5) Coleman Deluxe frame with lashed nylon-mesh band, $25—with sack, $50. (6) Eddie Bauer family: Explorer frame, $24.50, shown with two bags—Deluxe, $24.50, and standard, $2 less; Scout frame and bag, $20 each; and Mini duo, $11.50 each.

TENTS

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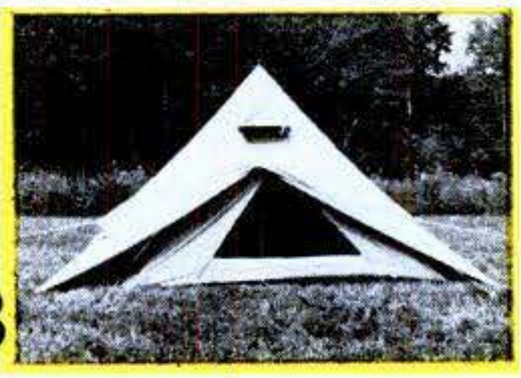
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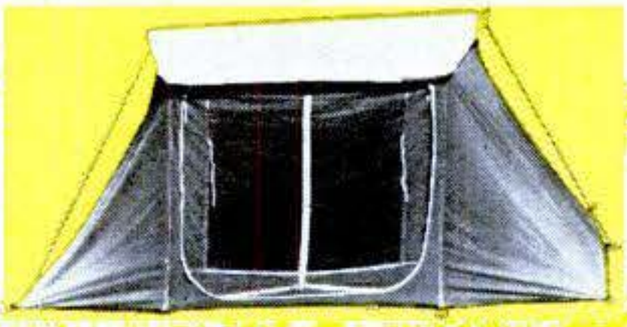
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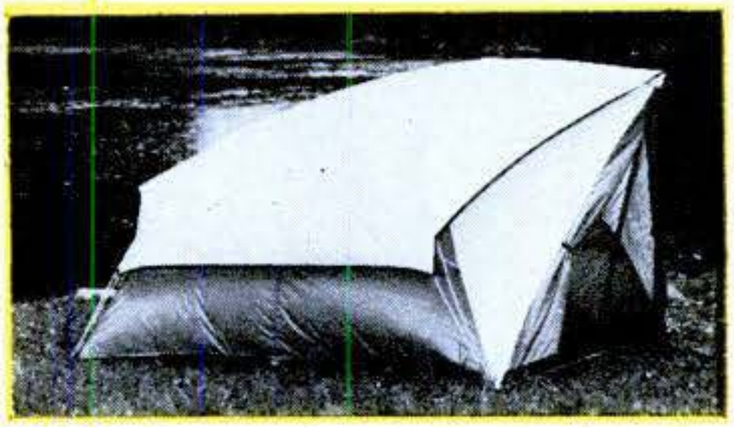
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Backpack shelters come in one- to four-man sizes: (1) Thermos two-man, 9-lb. Pocket Camper has zippered nylon net and storm flap, fiberglass ribs. (2) Gerry basic backpack outfit, $140 from Stow-A-Way, includes 3½-lb. solo Lodgepole. (3) Thermo Expedition, $140 from Moor & Mountain, weighs 5¾ lbs. (4) Coleman's 5¼-lb. backpack two-man, $60, has 48-in. ridge. (5) Ute Mountain's 1¾-lb. Inflat-A-Tent, $10, rolls up to fit in pocket. (6) Sears 15-lb. four-man has fiberglass ribs, zipper at both ends, $115.

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Mark IV is a stylish new conversion of Ford's Econoline built by Motor Homes, Inc. It can sleep six and has a complete galley and bath, including a shower.

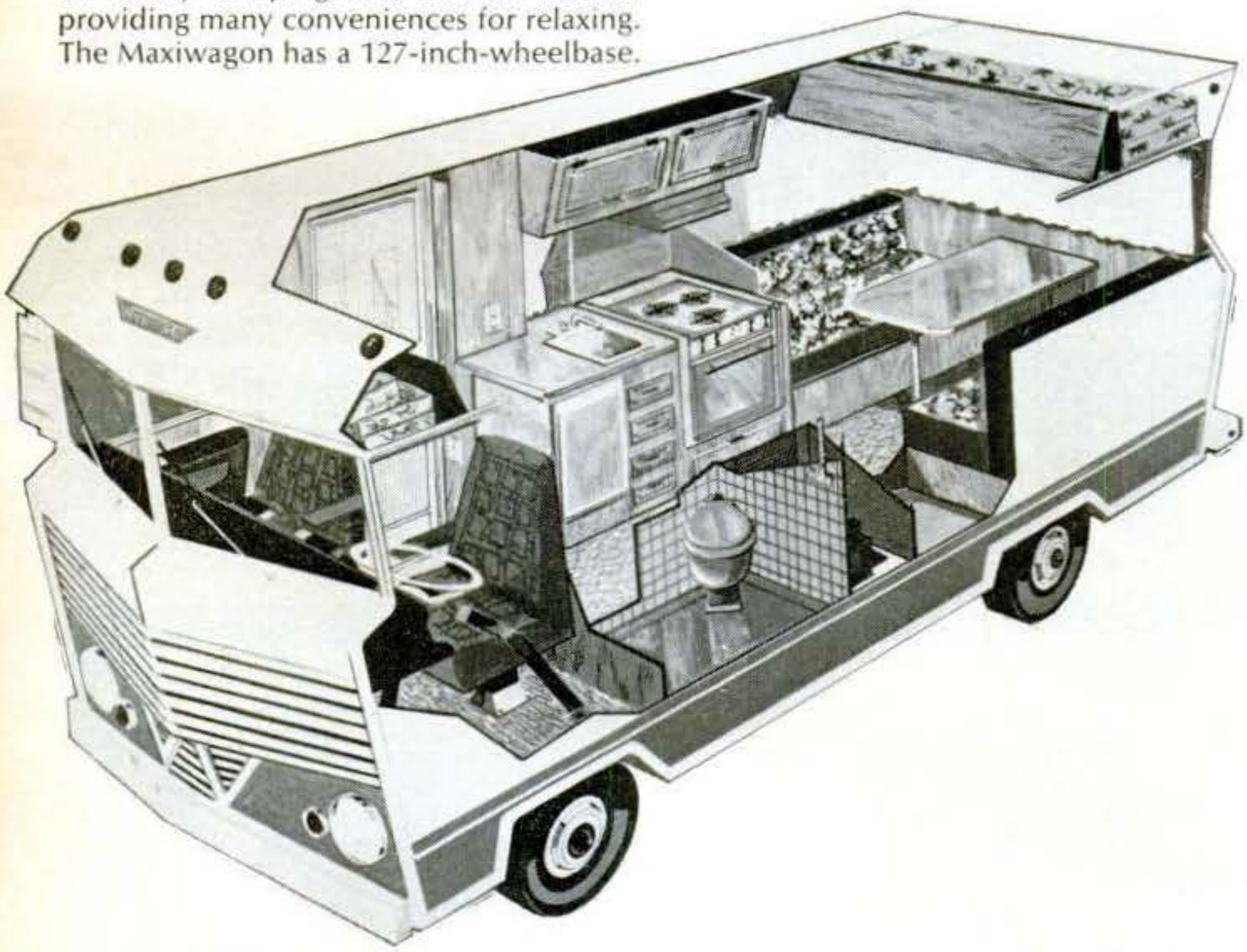
Chinook conversion of the Dodge Tradesman Maxiwagon has built-in ruggedness for heavy camping use, and an interior providing many conveniences for relaxing. The Maxiwagon has a 127-inch-wheelbase.

SLICK NEW RVs OFFER YOU

All the Comforts of

By HERBERT SHULDINER

Walking into a recreational vehicle today is like stepping into a beautiful, functional, and compact vacation home—but on wheels; one you can move at whim.



Winnebago's F-17 has over 590 cu. ft. of living space. It will bed down six, and provides you with shower, water heater, marine-type toilet, and full galley. It's built on a Ford P350 chassis and comes to you with a three-speed automatic transmission.

Sonora 112 is brand new to Gladding Del-Rey's line this year. The 9½-foot camper comes in stripped or fully equipped versions, and can sleep four to six. It's designed to fit over the top of any ½-ton pickup.

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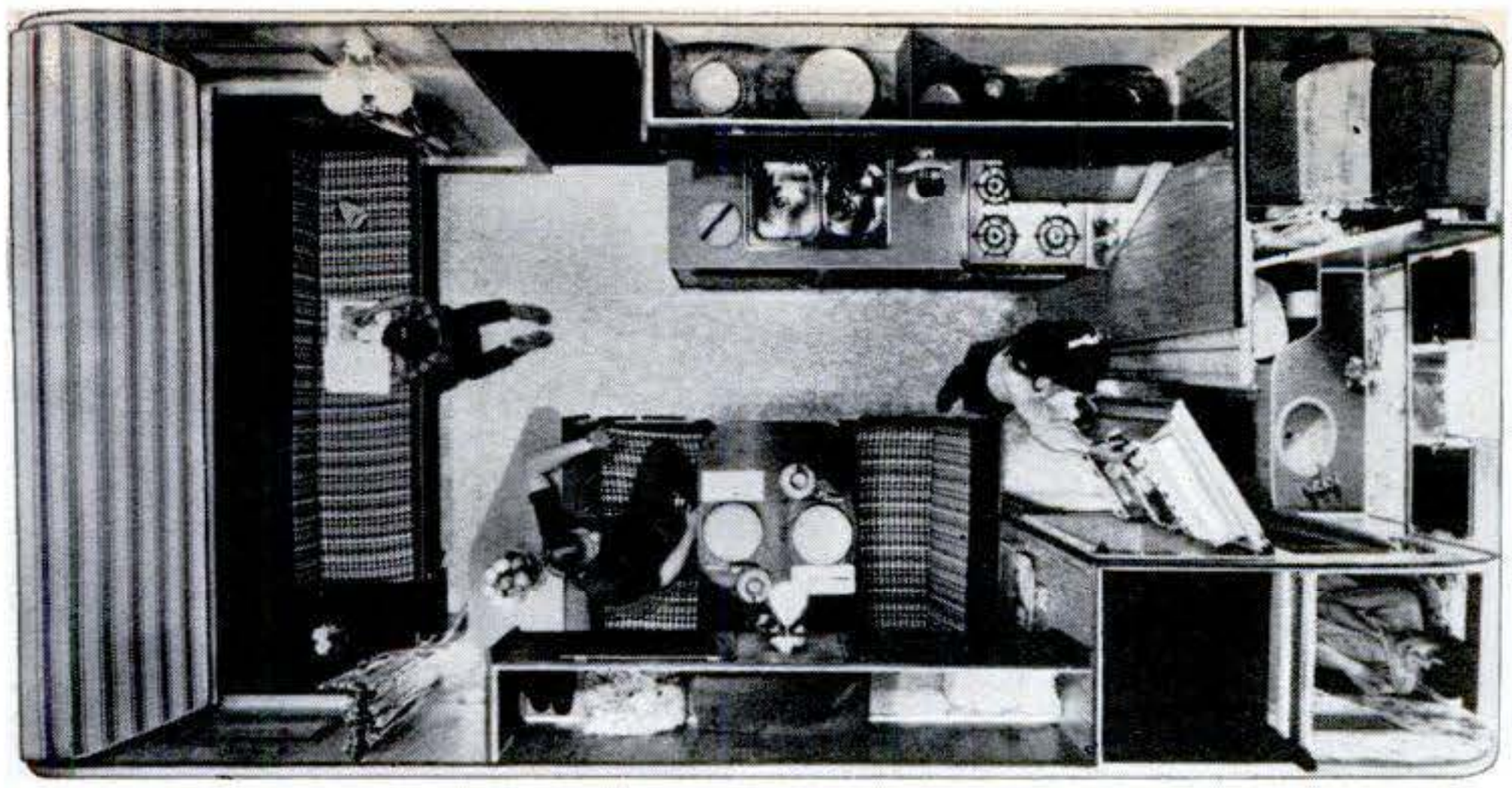

Real roominess and well-planned placement of galley, shower, dinette, and sleeping quarters are apparent in this view through the top of Corsair's 20-foot travel trailer. It's made by the Boise Cascade Recreational Vehicle Division.

Rolite's 1500 folding trailer is one of four models Larson has completely revamped this year. The 15-foot camper gives you all the convenience of a standard travel trailer (right), but folds (as at left) to ease towing. The 1500 sleeps four, has a full galley and heater. There's double-wall construction to increase insulation, a 110v AC system, and vinyl carpeting. And you get surge brakes. A 5,000-Btu furnace is optional.

Home–on Wheels

All the comforts and conveniences of your own home can be found in the 1971 collection of trailers, motor homes, pickup piggybacks, and caps —those campers that drop over only the bed of a pickup truck.

The latest RV phenomenon, however, is the mini motor home. It's mounted on a cutaway minibus—with the cab and chassis of a Ford Econoline, Dodge Sportsman, or Chevy Sportsvan used as a base. The camper extends over the cab, permitting walk-through access from cab to camper—so you can keep an eye on what the kids are doing in back. PS

New mini motor homes that have become popular recently are typified by Coachman's Leprechaun (left) and the El Dorado (right). These campers are mounted on a cutaway Ford Econoline. The design enables you to walk from the cab directly into the living quarters. This type of home-away-from-home is now being made by more than a dozen manufacturers. Some ride on chassis vans from Dodge and Chevy.

Kayot Wanderer, an 8½-foot camper, has a streamlined exterior that promises less wind resistance. Its redesigned interior gives a family more comfortable dining, sleeping, and lounging arrangements.

Dreamer Topper for pickups offers you an easy and economical way to get sleeping room for a short hunting or camping trip. It's available in two models: 32 inches high (shown here) and 26 inches high.

Wallaby—a telescoping trailer—doubles as camper and carrier for jeeps, tractors, or ATVs. It gives you almost 6½ feet of headroom when raised; lowers to six-foot-eight overall height for towing.

Starcraft's Wander Star 240 is one of five all-new models for '71. The front end is now rounded off to reduce wind resistance, and there's more interior space. There are electric brakes on all wheels.

Hi-Lo's telescoping camper turns into a fine home with ample headroom when it's raised like this. Cranking it down lowers wind resistance on the road. Top comes down to just above height of the cab.

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The Tent-Camper Revolution

New luxury and room help you live it up. And they're more durable and roadable

By HERBERT SHULDINER

Starcraft's Starmaster comes in six- or eight-sleeper models. Its bunks slide out easily, and there's vinyl overhead for every sleeper. The Starmaster also provides a roomier interior with big windows for bringing in lots of the outdoors.

Some startling new features in the '71 tent campers elevate this once-lowly camping vehicle into an almost luxurious vacation home:

- Canvas is replaced by roofs and walls of solid plastic in some models.
- Fully equipped modern galleys offer much of the convenience of your kitchen at home.
- King-size beds make for comfortable sleeping.
- Large-capacity dining areas provide lots of table room, and give big families plenty of space to spread out in between meals.

Among the most innovative of this year's models are the Apaches. The 1970 Apaches were the first tent campers to come with solid plastic sidewalls. This year, canvas has been totally eliminated in all but the lowest-priced model. Now even the roofs and walls of the bunks are of solid ABS thermoplastic.

Eliminating the canvas is the end of problems of shrinking, leaking, and mildew that occasionally plague owners of tent campers. It also allows Apache to use solid sliding windows and a self-storing aluminum door that stays attached to the front wall when you fold the vehicle down.

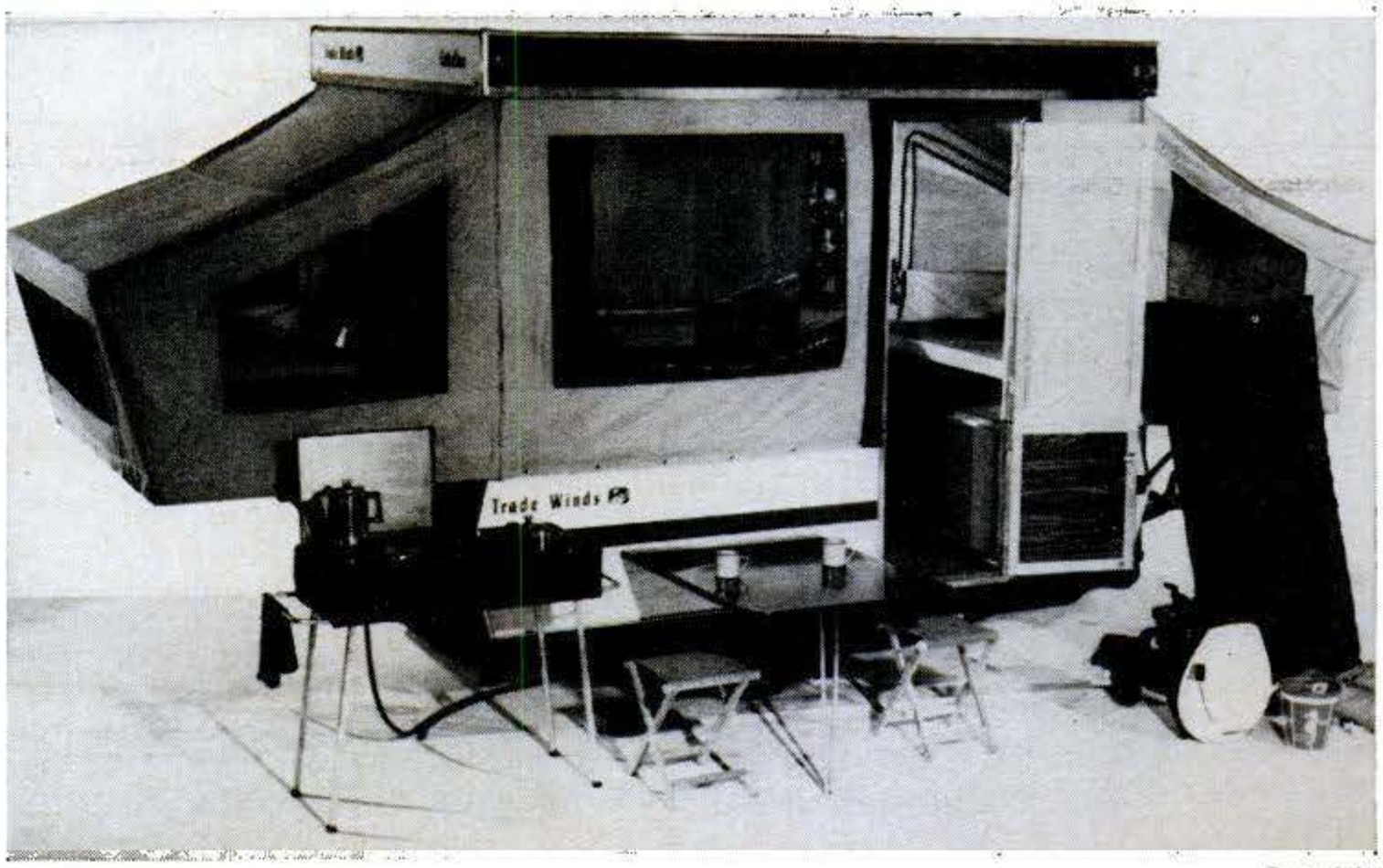
Those campers that retain the canvas have improved the material to eliminate interior condensation and provide better protection against the weather. Coleman's new tent campers have canvas that is backed with a wipe-clean vinyl interior over the bunks of its 580 and 590 series. The Coleman campers give you a new spring-loaded Hi-Lo galley that pops up when you set up and glides down and locks for traveling.

Nimrod has created a modular appliance setup that lets you customize the interior layout of the camper according to your likes and your budget. You can, for instance, install a single module with a sink and gas range. A second module adds an oven. A third adds a refrigerator.

Trade Winds has added a new dimension by designing its galleys so they can be used inside or out. In good weather, you lift the galley out and set it up outdoors.

Starcraft has improved its patented telescopic lifter system to cut setup time. It has also equipped all of its tent campers with external electrical receptacles—handy when you use add-on tent rooms. PS

The Coleman 580 has a low silhouette to give you good visibility through the rear-view mirror of your towing vehicle, here, (top photo), a Jeep Wagoneer. The camper's dinette table (seen in the lower photo) is removable for alfresco meals.



Trade Winds' Catalina has a unique galley—it's portable so you can cook meals outdoors, too. The camper sleeps six and has a big dinette to accommodate the half dozen.

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There's no canvas at all in Apache's revolutionary new Mesa (right). The slide-out bunks have rigid plastic walls and roof. Its smart-looking, spacious interior (above) provides you with an ample dining area, sleeping room for six, and plenty of storage.

Nimrod's new modular interiors (above) give you the option of equipping the Redwood (right) to match your purse and taste. The Redwood has an ingenious tailgate porch—an exclusive Nimrod design—which swings down when you set up the vehicle. It adds three feet of length, to make stepping inside easy.

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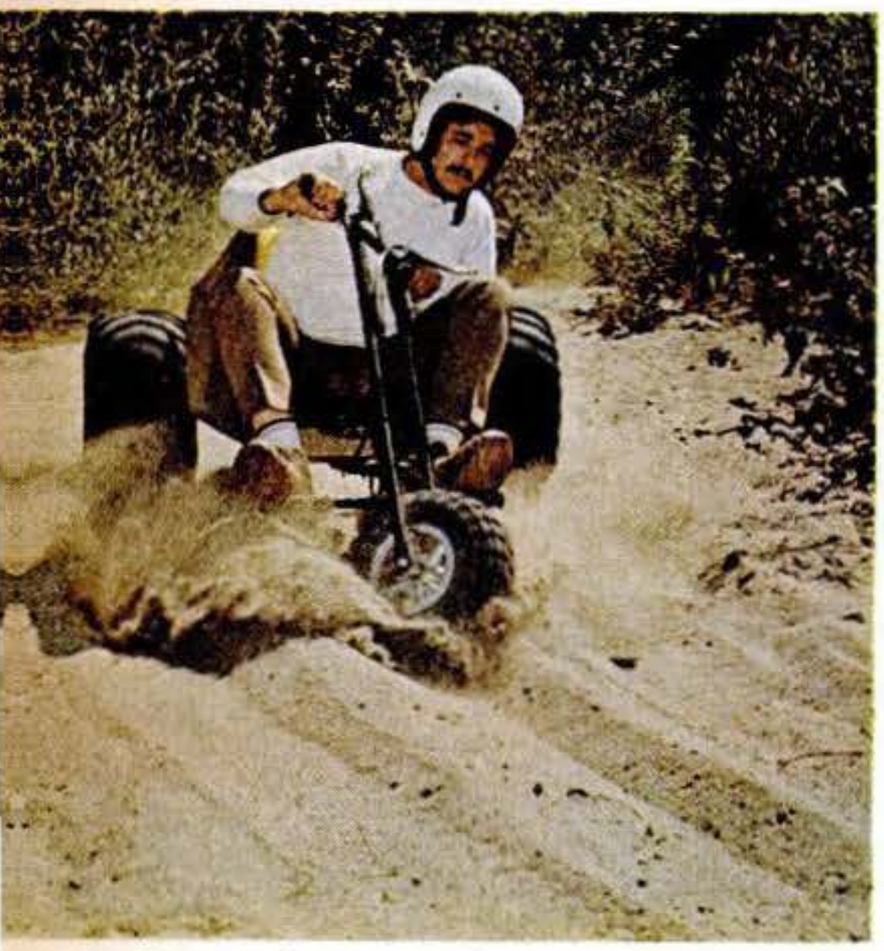
Speedster here is the Ruppster, a mini-dunebuggy that takes about anything rough terrain can dish out. Its 230cc two-cycle engine boots it to almost 40 mph



Dunecycle makes the dust fly as it takes tight corner. The three-wheeled minibike hits 30-mph top speed and will climb 40-degree hills. It weighs only 120 pounds.

Honda's ATC ushers in a new category for RTVs. Its six-horse four-stroker gives it exceptional climbing power, and its three big tires provide great traction.

Our beach party skims along the sands as the surf rolls in at beautiful Marco Island, Fla.

New Wheels

Whether you're partial to three-, four-, or six-wheelers, there's one made for you

By HERBERT SHULDINER
PHOTOS BY OZZIE SWEET

Bumping over fields, scampering up rocky hills, sloshing across ponds and streams, they go—the new breed of sports vehicle that's sparking a recreational boom in the boondocks. It seems to me, hardly a week goes by without the introduction of another three-, four-, or six-wheeler designed to carry outdoorsmen to places once inaccessible on wheels.

I've just taken a close look at six of the newest ones which, despite differences in appearance and engineering, are closely related in concept. They included a trio of three-wheelers, a four-wheeled mini-dunebuggy, and a pair of exceptionally well-engineered six-wheeled ATVs.

We put them through their paces at Marco Island—a sportsman's paradise just off Florida's Gulf Coast. We raced along white beaches, churned through swamps, and even plowed across ponds with the ATVs to see how they performed in water. Here's a rundown on what we found out:

- ATVs have the broadest performance capabilities of non-road vehicles. You can use them on almost any terrain, and in water. They also have biggest load-carrying capacity.
- Mini-dunebuggies: Closest in design to your car, they're the easiest off-road vehicles to learn to drive. They cannot be used in deep water, but perform well in sand and mud.

Continued

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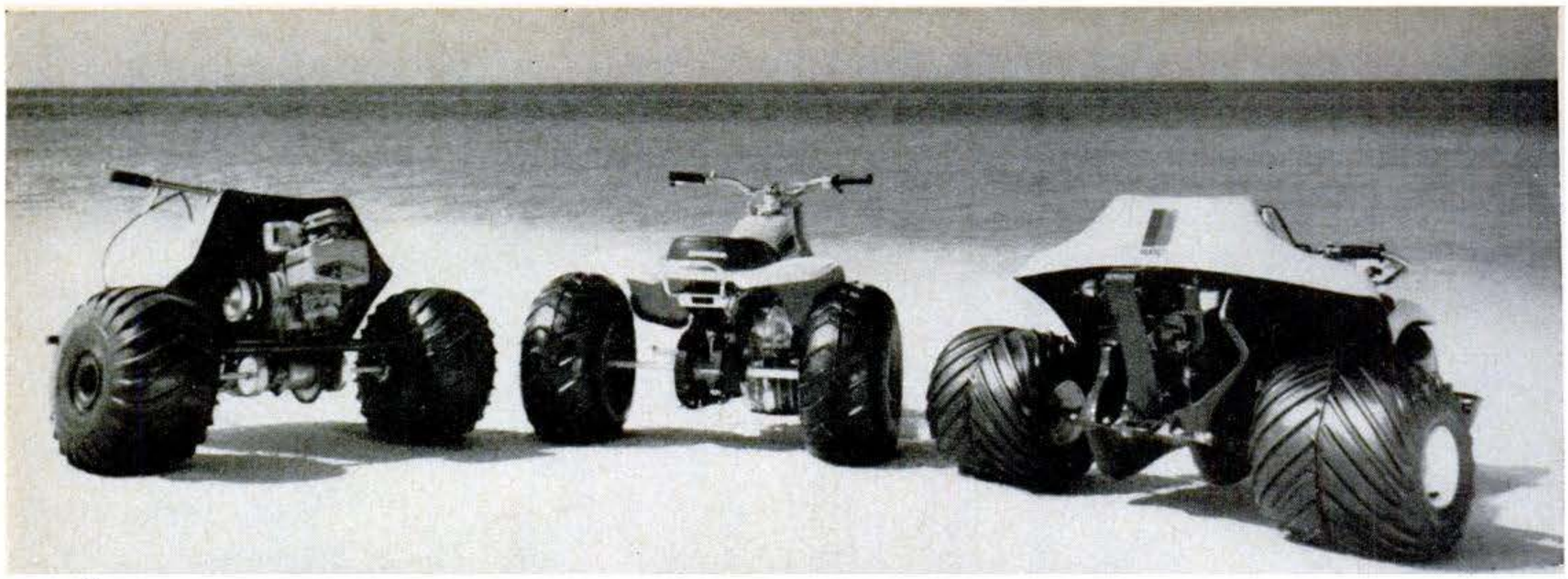
In the background (left to right): Dunecycle, Honda ATC, Ruppster, and Wedge ATV. In foreground: Sears Sportster ATV and a Tricart.

for the Wild Country ...which one is for you?

Jet pump powers a Wedge through pond at about eight mph—roughly double the water speed of an ATV without one. When entering water, you disengage power to wheels and switch to the pump, make your landfall, then transfer power back to the wheels.

Sears Sportster churns through water in conventional ATV manner, its turning wheels propelling it at about three or four mph—no handicap for crossing small ponds with no strong currents. But the Sportster, too, can be fitted with a jet pump.



Jaunty three-wheelers show off the wide stance that their rear wheels provide. The Dunecycle (left) and the Tricart (right) carry the engine farther to the rear than the new Honda ATC they are flanking. The Honda mounts its power plant amidships. Each of the vehicles is designed to give you fast access to the engine for maintenance or repairs. Because there are no suspension systems built into the three-wheelers, big low-pressure rear tires cushion the ride on all three of these rough-terrain vehicles.

Flip up the Dunecycle and you see how simply it's constructed: a frame, wheels, engine, transmission, and a plastic seat to top off the tricky little trike.

Tricart driver watches his own dust as he guns his vehicle up a hill. It has surprising scat with a four-cycle engine, but is even faster equipped with a two-cycle engine!

• Three-wheelers are often almost like minibikes. But some are more completely engineered for power and big performance. They're easiest to maneuver over forest trails, but have the smallest carrying capacity—usually one person.

The ATVs. The most complete of the off-road vehicles, these cost the most. The two we tested, Sears' Sportster and Sperry-Rand's Wedge, can be used as dune buggies, swamp buggies, or rough-terrain vehicles. And they're water babies.

The Wedge is especially well-suited for amphibious use; it's one of the first ATVs to be outfitted with a jet pump. It moves through water at up to eight mph, compared to about four for ATVs powered through water by their turning wheels.

Because ATVs are subjected to severe jolts from bumpy terrain and collisions with unseen tree stumps and rocks, they've suffered from a high incidence of structural failure.

Both the ATVs tested are built of thick fiberglass and steel. ATVs generally weigh in at about 500 pounds, but a Sportster or Wedge tips the scales at about 700 pounds. The Wedge, in addition to its thicker fiberglass body, has two heavy steel skids across the bottom for protection if a raised object is hit at high speed.

The Sportster ($1,695) closely resembles conventional ATVs in styling and handling controls. It has the traditional bathtub-like design and twin-lever steering. Each lever controls one set of three wheels. To turn left, you pull back one lever; the harder you pull, the quicker the turn. You turn by locking the wheels on the side toward which you're steering. Pulling back both levers locks all six wheels.

Sperry's new Wedge (also $1,695, plus $340 for factory-installed jet pump) drives more like a car. Turning its steering wheel to lock position accomplishes the same thing as pulling back a lever on the Sportster.

Both ATVs have foot-controlled brakes and accelerators. The Wedge has disk brakes that operate independently of the transmission. The Sportster has self-energizing band brakes controlled by the levers, and disk brakes operated by foot pedal.

Both ATVs carry three people, including the driver, but the passengers never have anywhere near the fun that the driver has.

The mini-dunebuggy. Midway in price and performance in our six test vehicles is the four-wheeled Ruppster ($995, plus $100 for electric start). It differs from standard dune buggies in that it is made on a specially designed chassis, not a shortened VW chassis. It is powered by a two-stroke engine, not a VW power plant. It is also smaller and not anywhere near as powerful or speedy as a standard dune buggy.

This mini is actually a big go-kart with fat ATV-type wheels. And it has the go-kart's simple, but sturdy construction. Although it has only rear-wheel drive, it has good traction for slogging through mud and sand. It is equipped with foot-operated accelerator, rear disk brakes, and auto-type steering wheel. Turning radius is 10 feet, aided by its rack-and-pinion steering. A 230cc, 14-hp JLO transmits power through a torque converter—the same one used in Rupp snowmobiles.

The final drive, enclosed, uses a ring gear and pinion instead of chain. Rupp eliminated the chain—a traditional maintenance headache in such vehicles—and claims greatly increased reliability. Gear ratio is 10.20:1. Top

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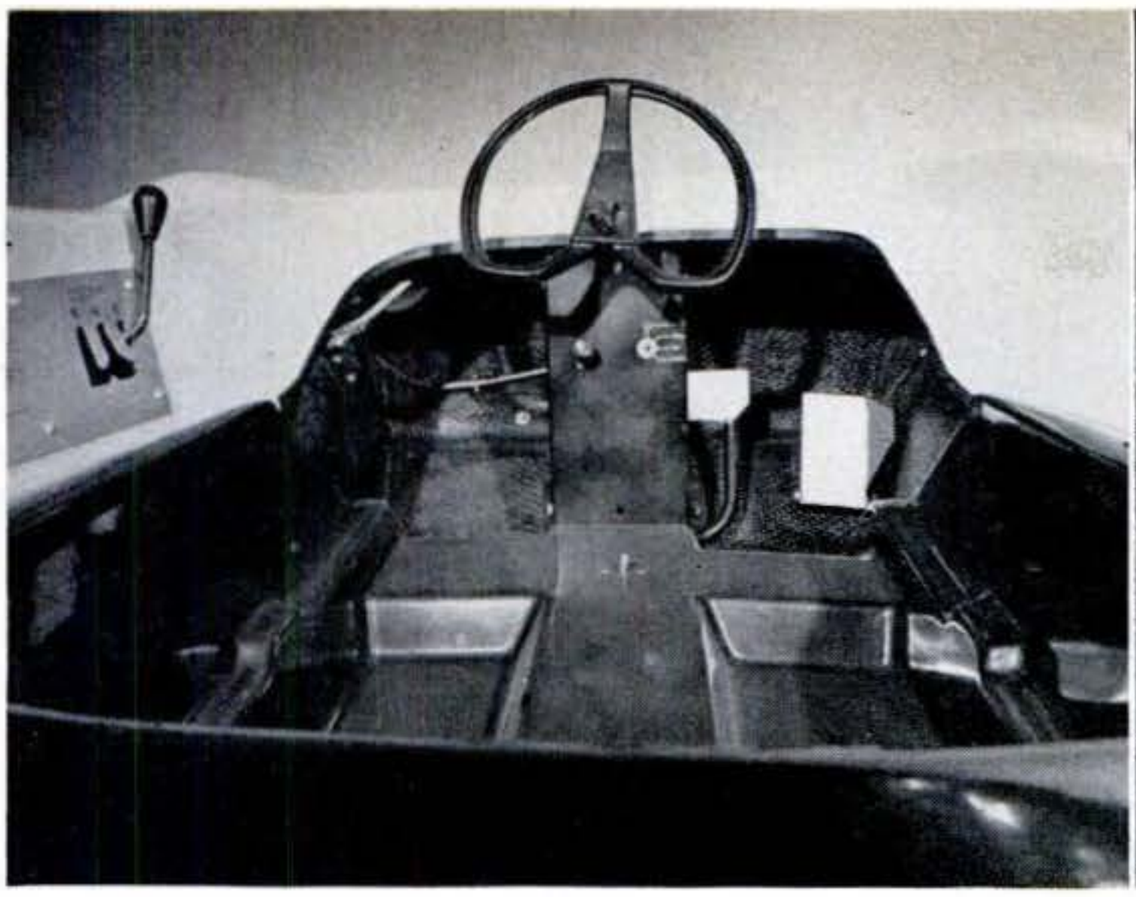


Controls on the Wedge are similar to a car's. Accelerator and brake pedals are on the floor and a steering wheel turns the vehicle. Transmission lever is at left. Driver sits solo in front and there are two rear seats to take passengers aboard.

In the Sportster, twin control sticks serve for steering and for braking the vehicle. The transmission lever is located to the right of the driver, just above the floor. There are also the familiar brake and accelerator pedals located on the floor.

speed is 38 mph—fine for driving over beach and back country. The Ruppster is not a road vehicle.

The lack of suspension makes for a rather bumpy ride, of course. And keeping a steady foot on the gas pedal is tricky. With your feet bouncing up and down, acceleration tends to be herky-jerky. The accelerator and brake pedals are inconveniently crowded together, too. But all in all, I found the Ruppster gives a lively and enjoyable ride.

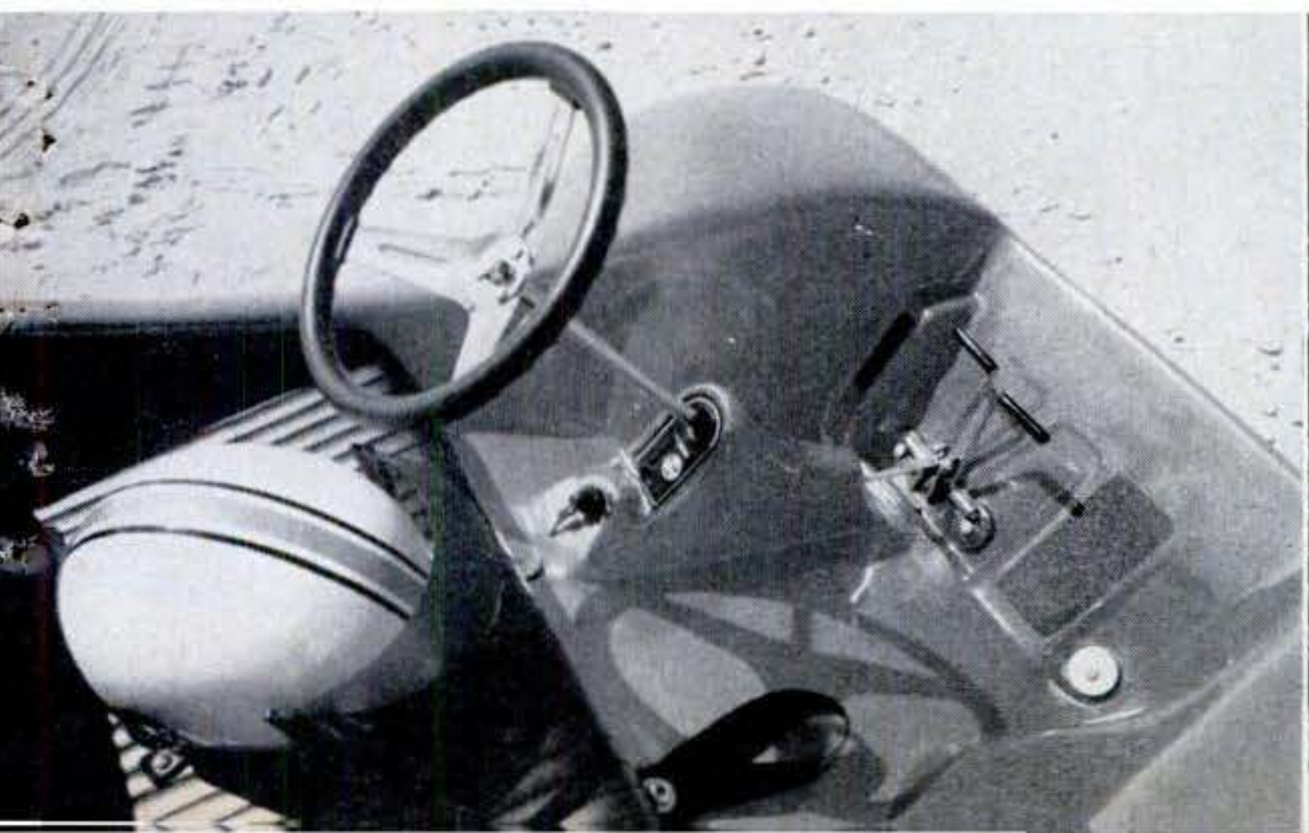
The three-wheelers. These are the newest of the six tested. They are designed to generate the same kind of excitement as snowmobiles. But they go about it in somewhat different ways.

The least expensive in the group ($475) and the smallest (weight: 120 pounds) is the Dunecycle. It's powered by a 200cc, five-hp Briggs & Stratton four-cycle engine, yet it can hit a top speed of 30 mph. For a non-road vehicle, that's plenty of speed

[Continued on page 124]

Etching turn radius in sand, Sears Sportster (foreground) and Wedge display phenomenal turning ability. Both turn in own length by locking wheels on one side. Sportster locks left or right wheels as you pull stick back. The Wedge uses a steering wheel.

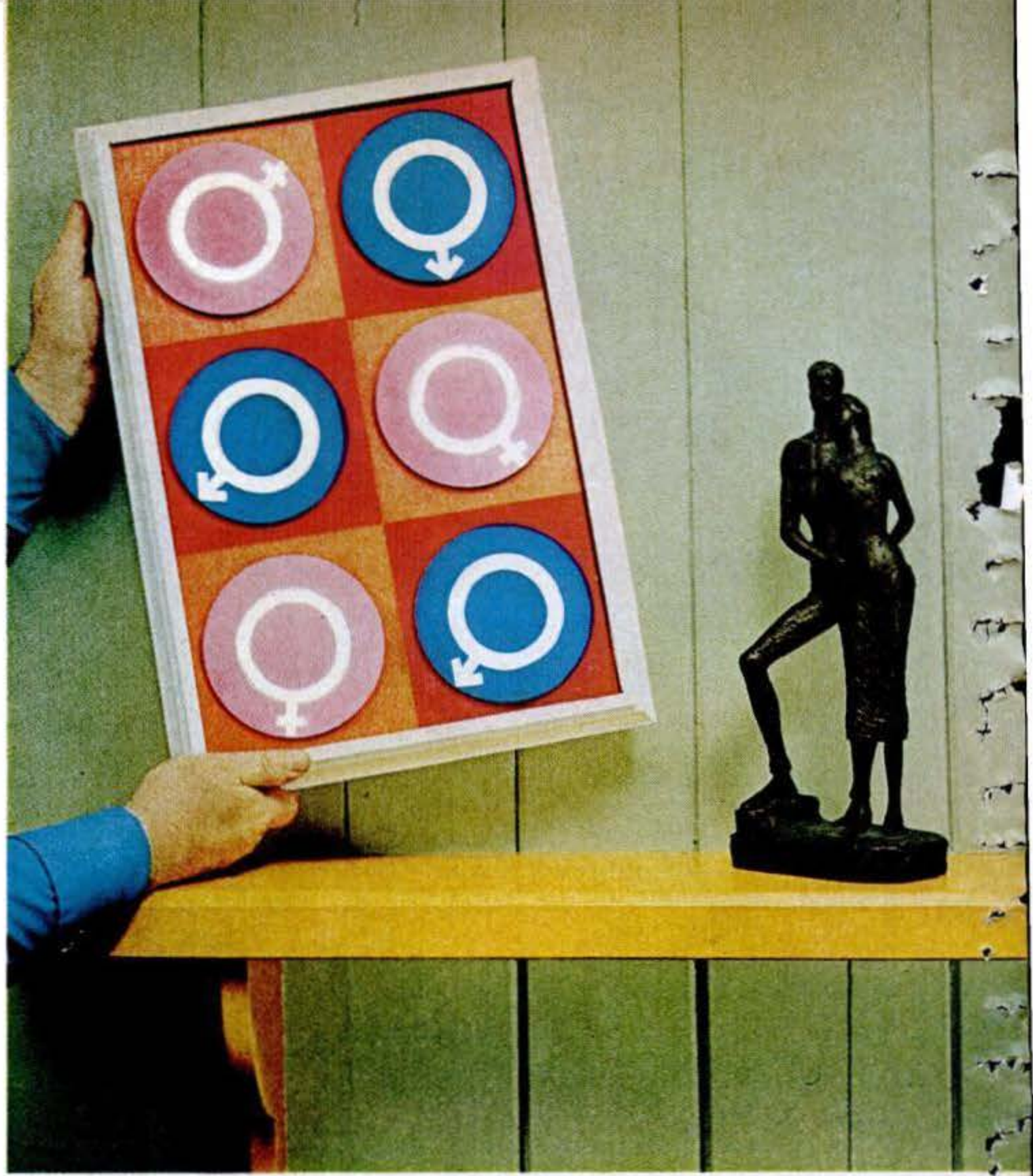
Ruppster has extremely simple controls: It changes direction at a turn of the wheel and the steering is quick. Pedal at left is the brake and the accelerator is on the right. That seat will hold two comfortably. The vehicle is light and small enough to be easily fitted into the rear of a station wagon. It can also be trailered piggyback on a snowmobile or fitted into a utility trailer.



Popular Science Introduces the Picture Clock

This new home accessory has a secret. How does it tell you the time? All of your friends will want to know

By ROBERT P. STEVENSON
Editor, Projects & Activities



HE AND SHE. For a modern home, how could you beat this eye-catching arrangement of sex symbols used in scientific literature? The time? 7:25.

In grandfather's day, the clocks in a home were among its finest adornments. Then, for years, clocks became time-telling drabs. Recently, makers have begun making them ornamental again. Now, a famous artist has gone all the way—and converted clocks into beautiful paintings to decorate your walls.

A picture clock is the newest home accessory. It's practical. It keeps good time. It's also fun. Because a picture clock is not immediately recognizable as a clock, it's a mystery. How does it show the time? Those not in the know—will want to know. The new timepieces are great conversation pieces.

Picture clocks are the ingenious conception of Roy Doty, who based the concept on innovative paintings by a fellow artist and friend, Arnold Hoffman Jr.

POPULAR SCIENCE this month is introducing clocks in five different styles, each one based on an original Doty painting. The clocks measure about 13½ inches by 20 inches.

HIGH GEAR. Those who like machinery ought to react favorably to this symbolic arrangement of gears and belts. And what time does it tell? Eh? Figure it out? 9:20.

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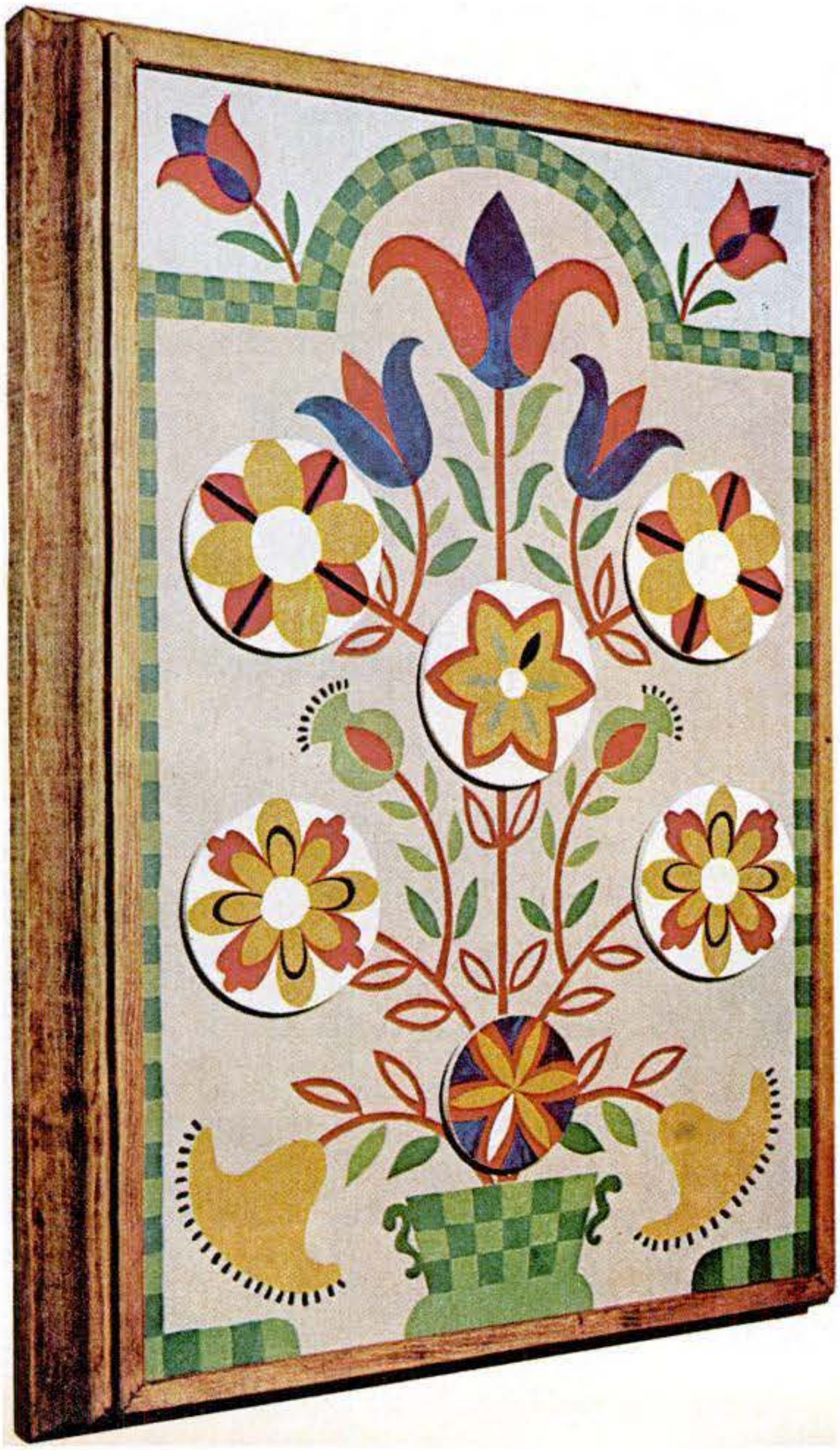
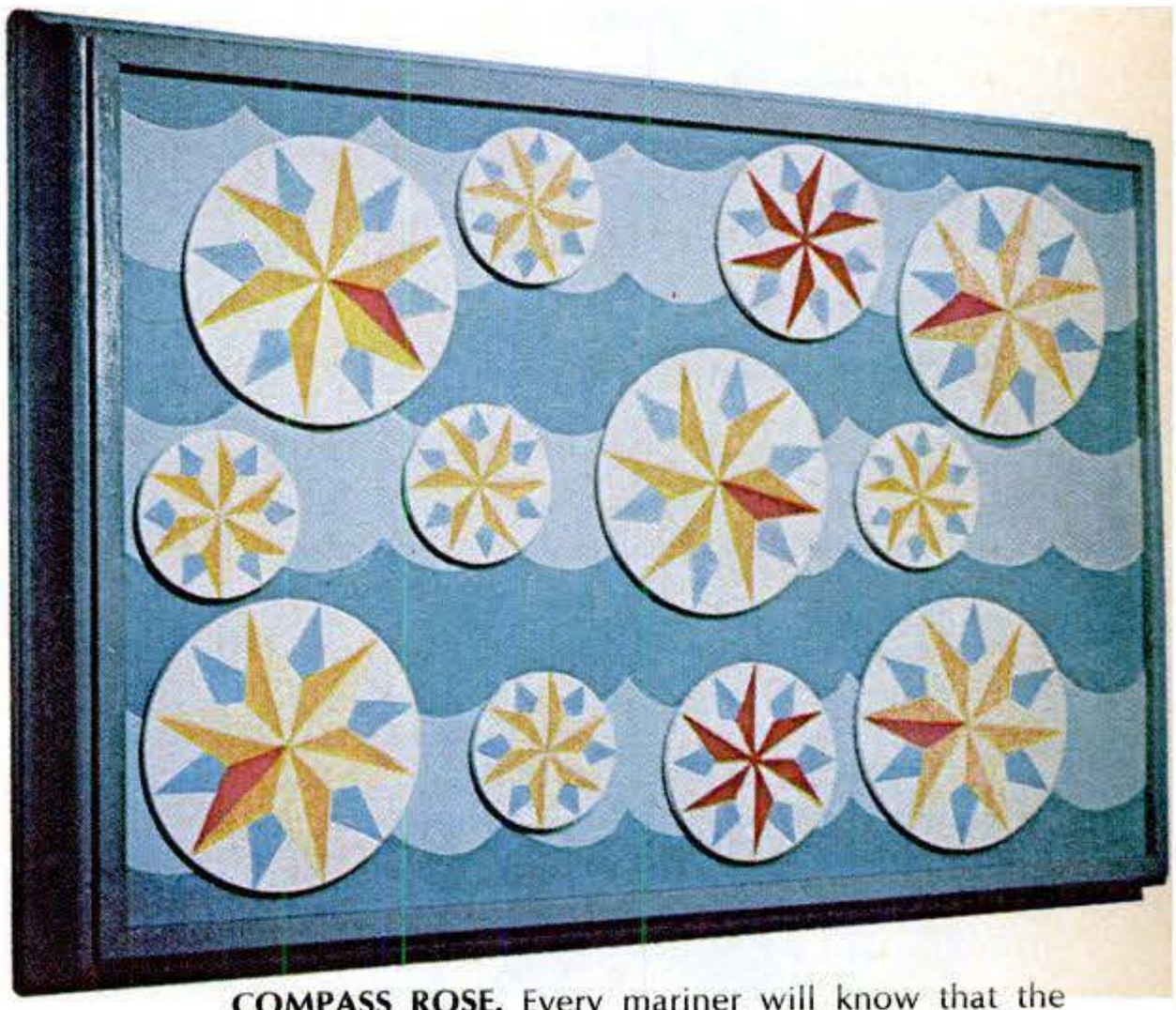
LADY BUGS. You might also like to call this delightful collection of gardener's friends the "Fly Away Home." Imaginative youngsters should like it, too. The time it's telling—1:40.

PENNSYLVANIA DUTCH. Perhaps you want a clock to suit a home in which the furnishings are traditional. The design below comes directly from Lancaster County furniture. Time—1:35.





COMPASS ROSE. Every mariner will know that the symbols used so colorfully among these blue waves indicate the points of compass. The time—3:45.

FOR HOW TO READ—AND GET—A PICTURE CLOCK, PLEASE TURN THE PAGE

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THE ARTIST WHO INVENTED PICTURE CLOCKS. Roy Doty, in his studio (left), puts finishing touches to one of his paintings offered as the face of a picture clock. In the background is a finished clock.

Roy says that the idea came to him from paintings of clocks made by a long-time friend and fellow artist, Arnold Hoffman Jr. Hoffman's paintings are seen in many museums and private collections.

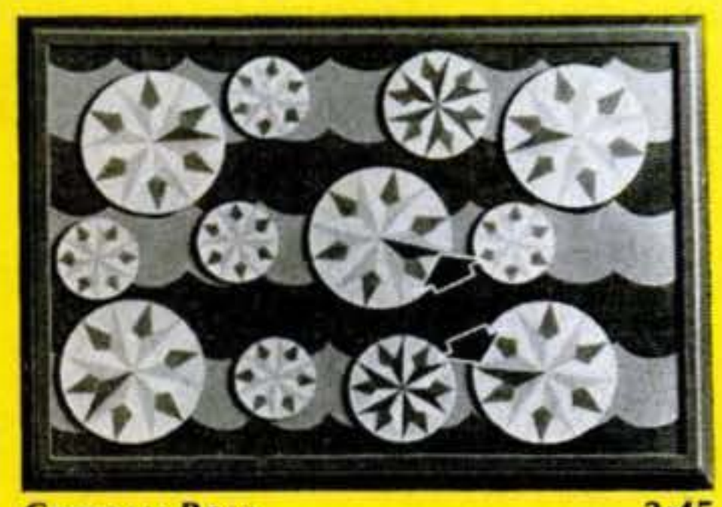
Roy tells an anecdote about the first picture clock he created. He was showing it off to a visitor to his home, a psychiatrist. The doctor loved the clock. He asked Roy to name a price. Roy did: $150. The doctor paid—and now uses the clock in his office. He no longer has to be obvious, checking his wristwatch, to see when the consultation period has passed.

Roy Doty is one of the most inventive and mechanically ingenious men I have met in a quarter of a century as an editor of Popular Science. He is also one of the greatest wits I know.

You may know Doty as the creator of our Wordless Workshop, but he also draws a daily newspaper comic strip, "Laugh-in"; does periodic illustrations for a magazine that accompanies the popular TV educational program, "Sesame Street"; and he draws regular covers and illustrations for many magazines. You may already have seen him on a national television program when he presented—and had some fun with—his new picture clocks.—Robert P. Stevenson

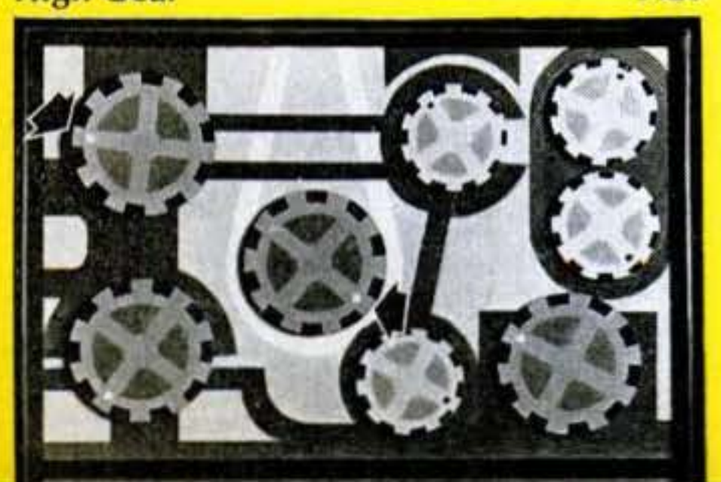
Here's where you learn a picture clock's secrets

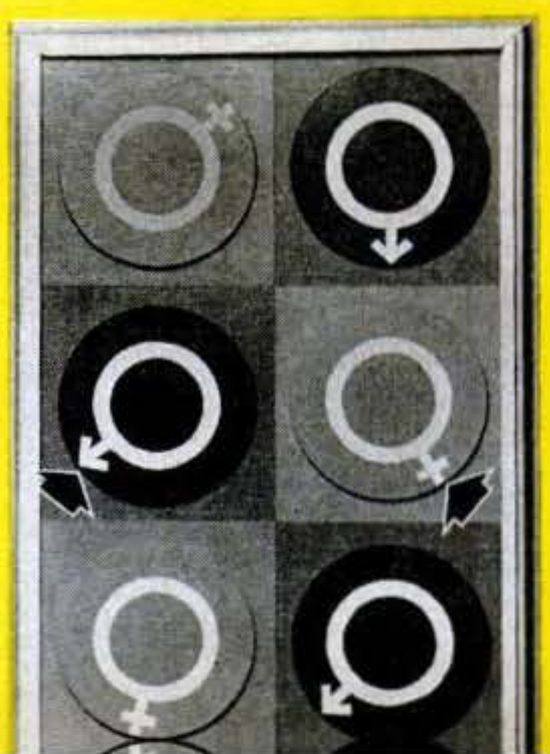
Two elements revolve in a picture clock. One, usually at the left or above, indicates the hour; the other, the minutes. All you must remember is which are the two revolving elements. Battery-driven clock works are hidden at back of picture. An offset shaft turns hour hand. Arrows in photos indicate time elements.

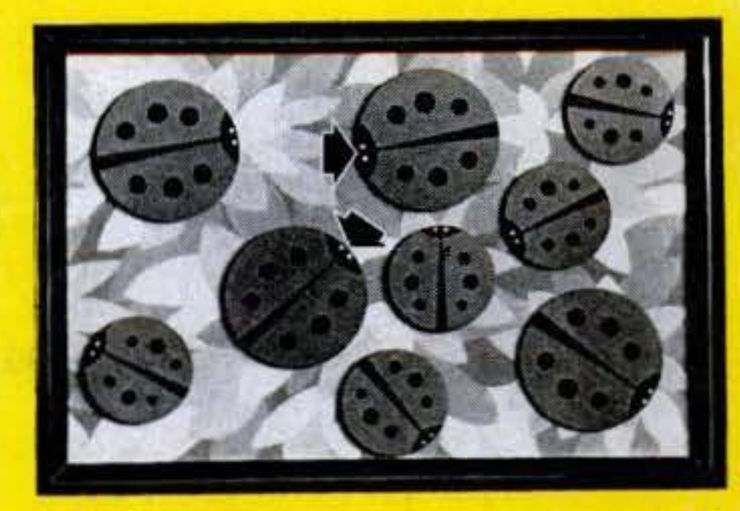


Compass Rose 3:45

High Gear 9:20





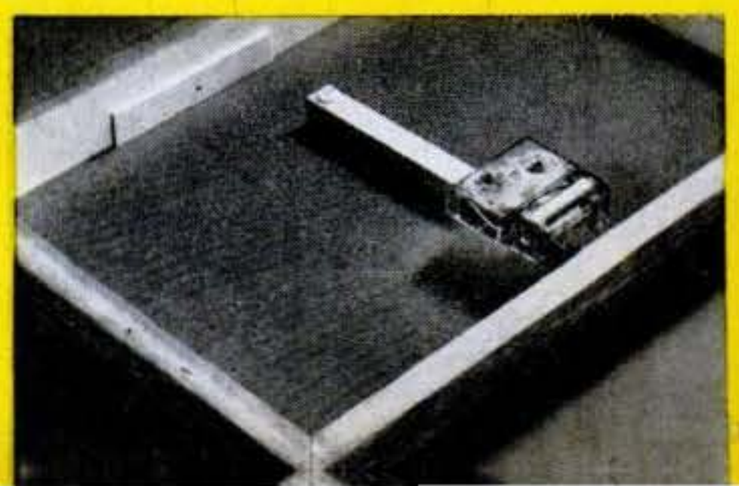


Lady Bugs 1:40

← **Pennsylvania Dutch** 1:35

He and She 7:25 ←

Here's the works: Belt inside an aluminum guard turns the hour hand on offset shaft. The same mechanism fits all the clocks.



Throw Away Your Old-Fashioned Clocks. Picture Clocks Are the Modern Way to Tell Time

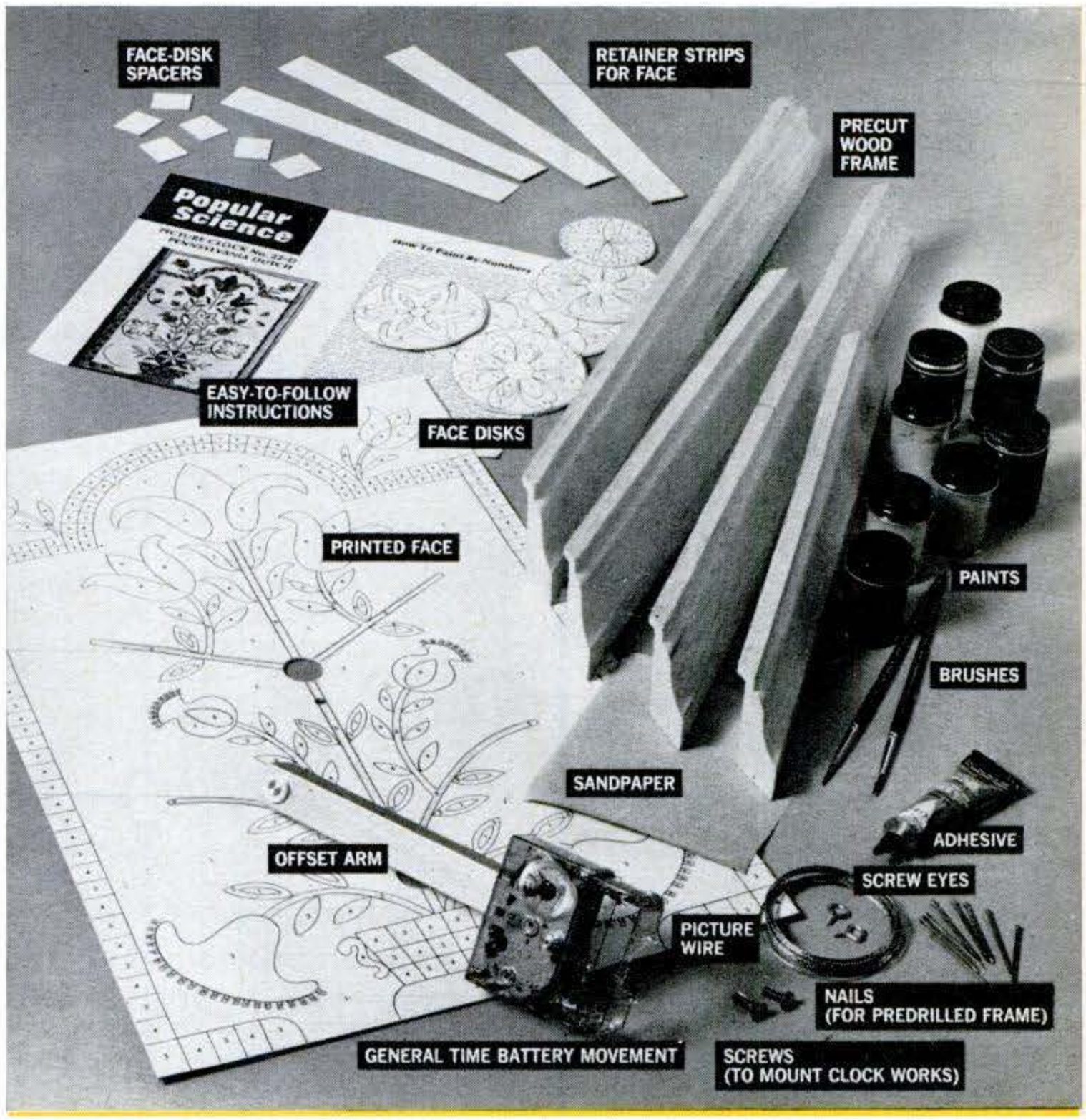
MODERN ornamental clocks can bring a lot of beauty to your home—but only half as much as a clock that's also a colorful 13½-inch-by-20-inch painting for your wall.

Visitors to your home will never dream that the beautiful painting is also a timepiece. And even when they do, only those in the know will be able to tell the time. You buy a picture clock as a kit, assemble frame and clock works, and recreate the Roy Doty painting by the popular and simple paint-by-numbers method.

The kit includes ready-mixed paints matching the bright modern colors that you see in the Doty paintings in the photos on the preceding pages. However, if those do not blend with the color scheme of your walls and furnishings, choose colors that do —and paint the pictures to complement your home. Suitable paints are readily available. The sequence of numbers printed on the 12-inch-by-18-inch clock face suggest the proper painting order—as do the same numbers on the circular elements. After painting the circles, you cement them to the clock face.

The only tools you need to put together one of the kits are a hammer and a screwdriver. Holes are drilled on each clock face, properly spaced to take the hour and minute shafts. There are also screw holes for fastening the mechanism to the back of the clock face.

Each kit contains everything you should need to complete your clock, except a battery—and finish for the frame. Again, you can choose any finish that pleases the decorator in your home. The color photos on the preceding pages show some possible finishes you might use.



Greatest clock invention in 462 years—yours for $18.95

Not since the invention of the coiled-spring clock in 1509 has there been such clock-making news—as the picture clock. Photo above shows the typical parts you get in the kit you buy.

How to give a clock party

WHEN you have finished your clock, you might want to have some fun with it. Invite friends to your home—into the room where you have your new clock, but no other.

Tell your friends you are making an experiment. Ask them to note the time on their wristwatches and then tell them you can tell time—without a watch. Do so.

Repeat this several times during the evening—or until everyone demands an explanation of your mysterious powers.

Have fun. PS

Use this coupon to order clock kits shown on pages 90 and 91

Popular Science Clock Dept.
Box 1100, Teaneck, N.J. 07666

I enclose $_____ (check or money order; NO CASH).
Please send me the Clock Kit(s) that I have circled below, at the bargain price of $18.95 each.

Name_____

Address_____

City_____

State_____ Zip_____

HE AND SHE	**(22-A)**	**PENNSYLVANIA DUTCH**	**(22-D)**
HIGH GEAR	**(22-B)**	**COMPASS ROSE**	**(22-E)**
LADY BUGS	**(22-C)**		

IMPORTANT: CIRCLE the name of the clock kit(s) you want.
Allow three to four weeks for delivery.
ACT AT ONCE for earliest delivery.

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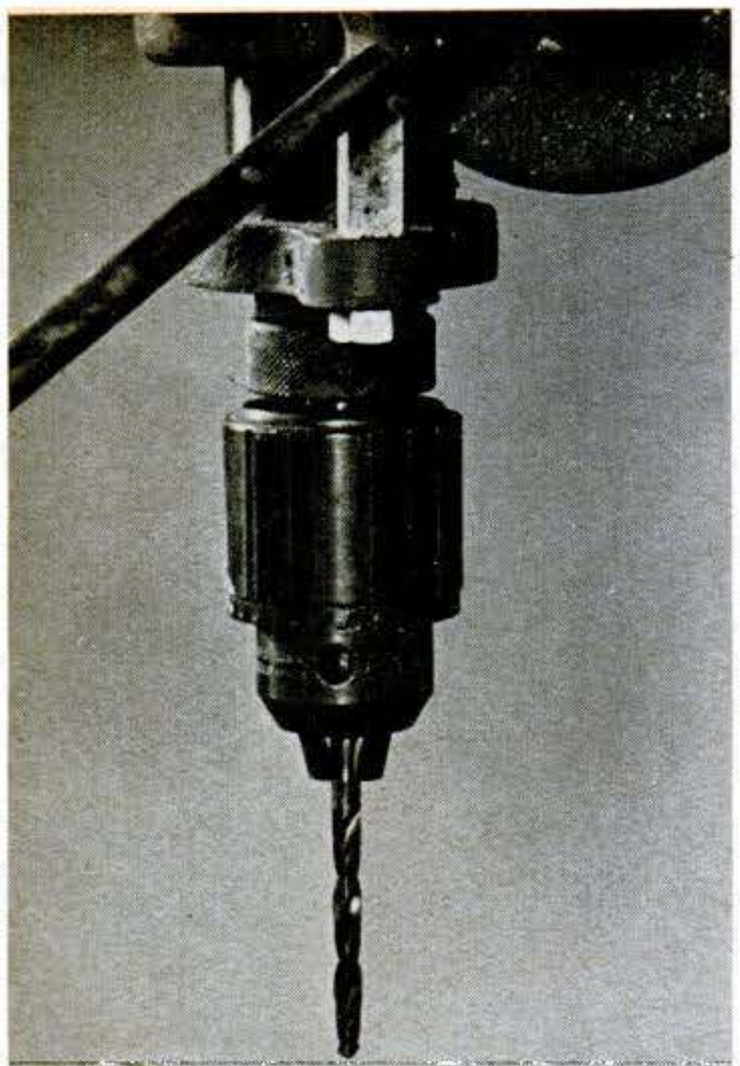
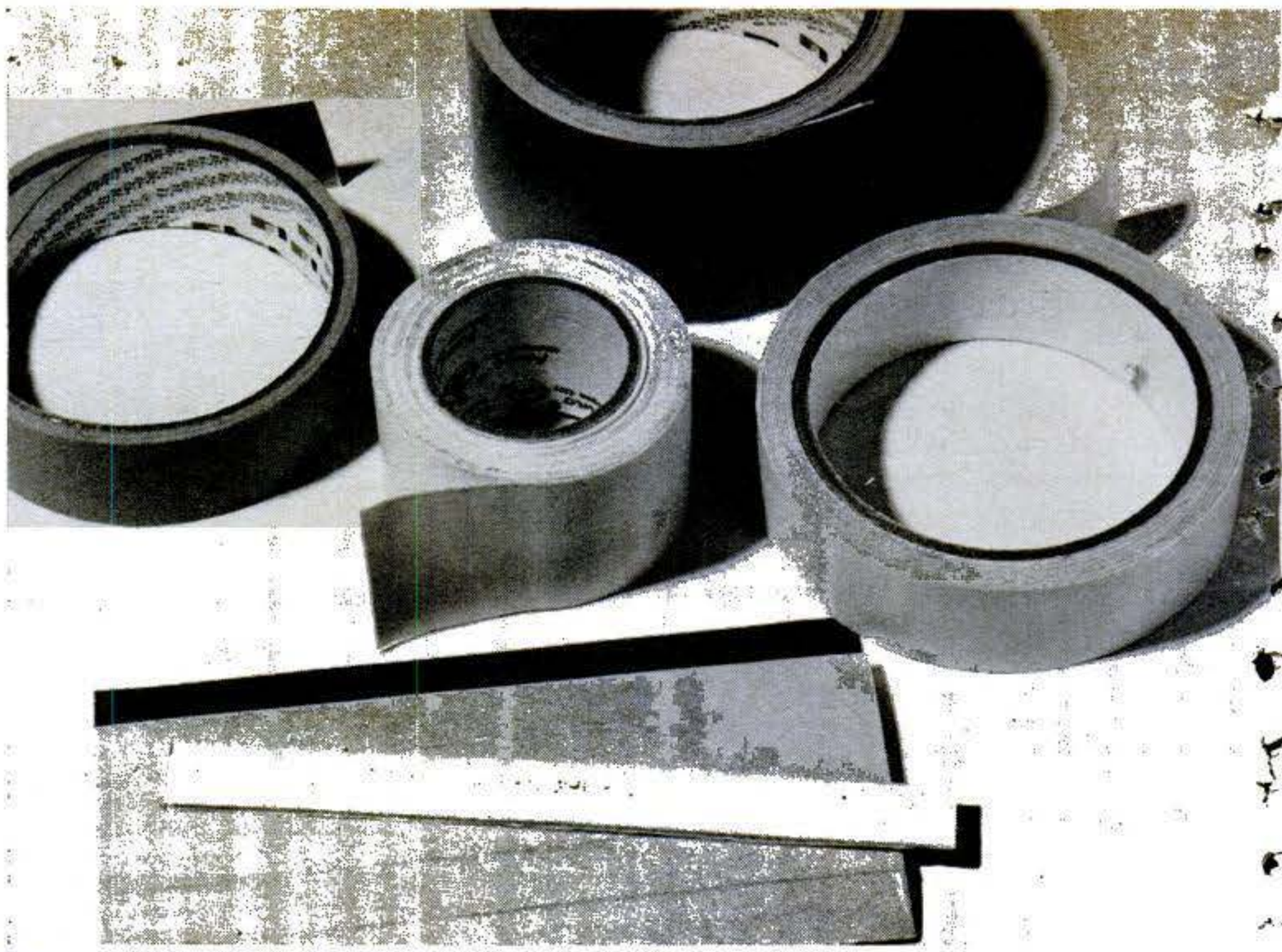


When you're drilling sheet metal, fasten it down on the bed of the drill press with double-faced tape and the work won't spin out of your fingers.



They come in rolls, strips, patches, on various backing materials. Pick a foam tape for irregular surfaces; a cloth tape for strength on textured, level surfaces; thin film (Mylar) when you're working with a smooth, flat material—like metal.

Two-Faced Tapes

Those handy tapes with the stickum on both sides should be better known to all of us

By JACKSON HAND

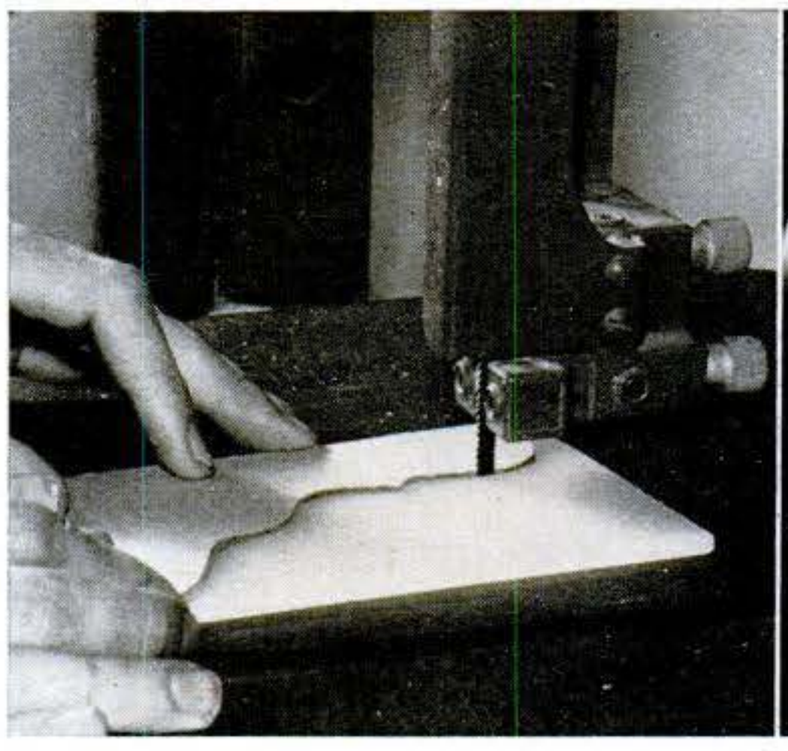
Double-coated tape is a fine new candidate to add to your list of home and workshop helpers. Try a few of the tapes, and I'll wager you'll never want to be without them.

In industry, they have replaced nuts and bolts and other fasteners in many operations—and do a better job at less cost.

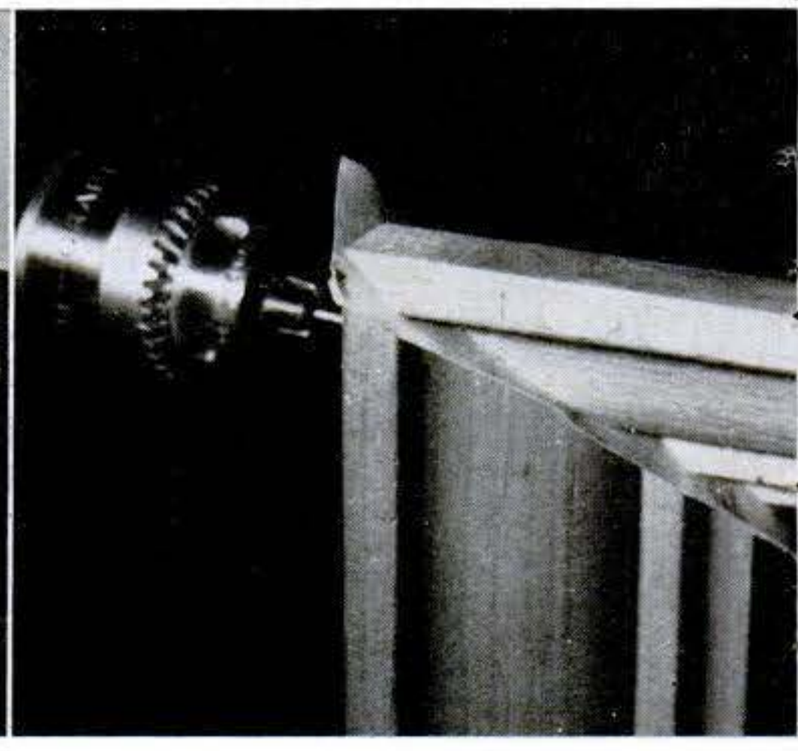
The tapes take advantage of new pressure-sensitive adhesives. Double-coated (DC) tapes vary in stickiness. Some joints can be considered final; others can be separated and rejoined. Some latex coatings are formulated specifically for resistance to extreme cold, heat, or wet. Some are particularly resistant to chemicals.

The backings contribute to versatility, too. Paper, cloth, plastic foams, and plastic films serve special purposes. A thin, tough plastic foam will

Carpet tape is fine for many jobs. Use it for mounting a strip of abrasive on sanding drum, fabricating sander belts, and mounting felt on sanding blocks.



Double-faced tape offers a quick and easy way to secure a cutting pattern to a workpiece. After the cut has been made, the pattern will lift off the piece cleanly.



Tape makes the ideal third hand for hard-to-handle materials. After the hole was drilled in this crown molding, the tape was stripped away with no fuss.

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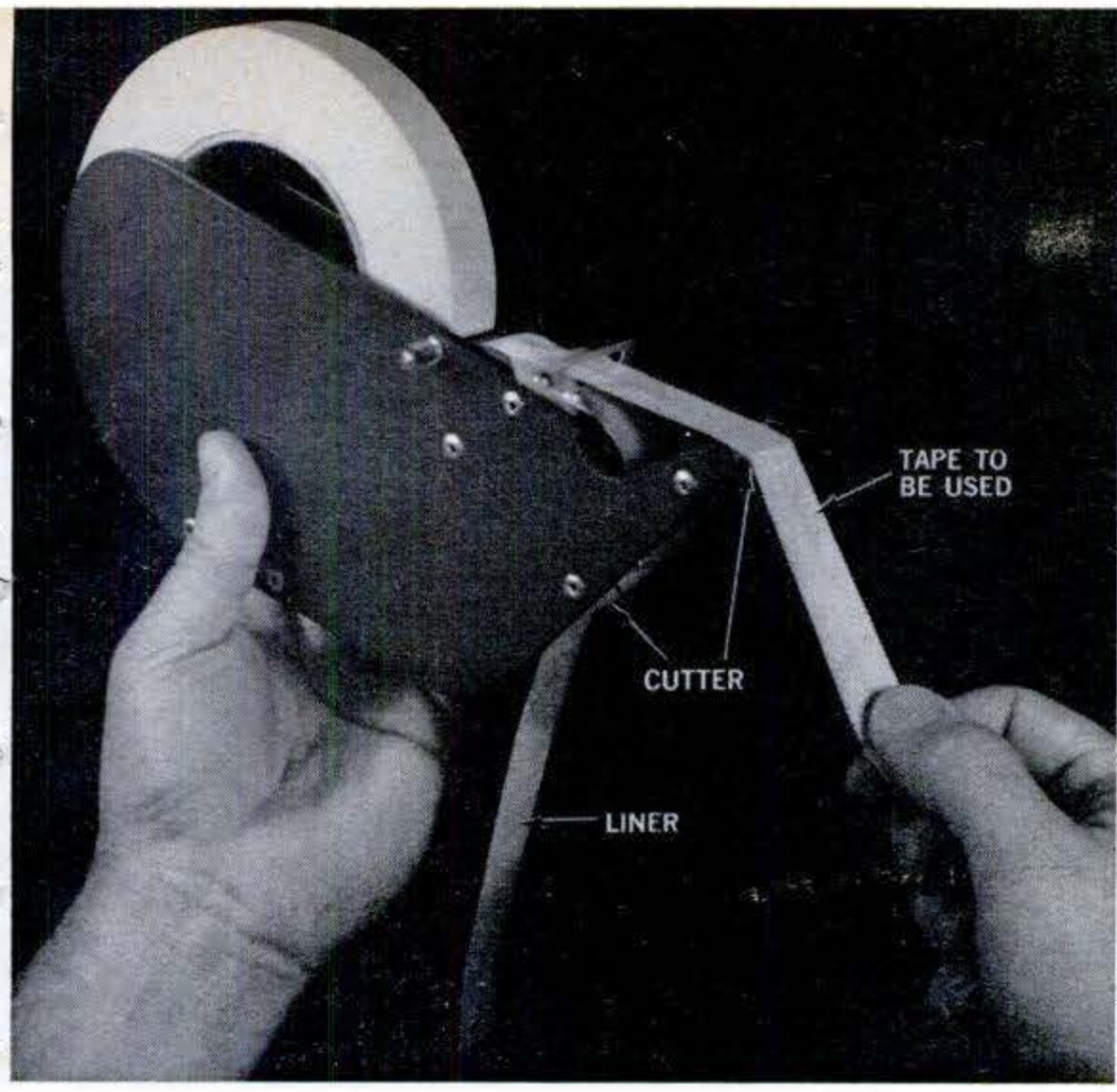
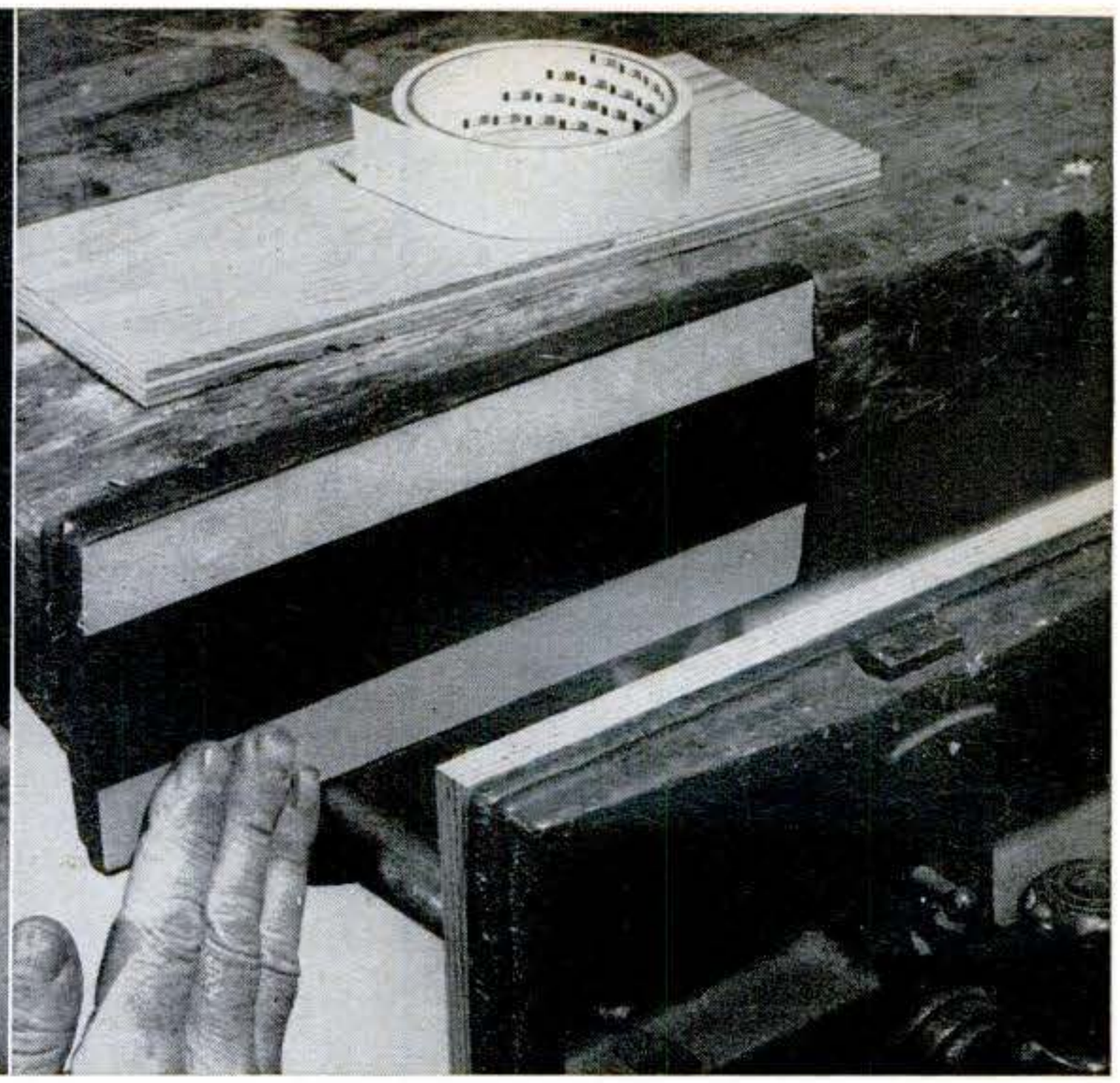


A special dispenser like this one is handy. It separates liner from tape, has cutter for each. You can order it for $12.95 (plus shipping) from Swell Products Co., Fairfield, Conn. 06430.



Plywood jaw facers are easily mounted in woodworking vise. Put two strips of tape behind each rectangular facer. Tape will hold until plywood is beaten up. Then the facers are easily replaced.

Do Honest Shop Jobs

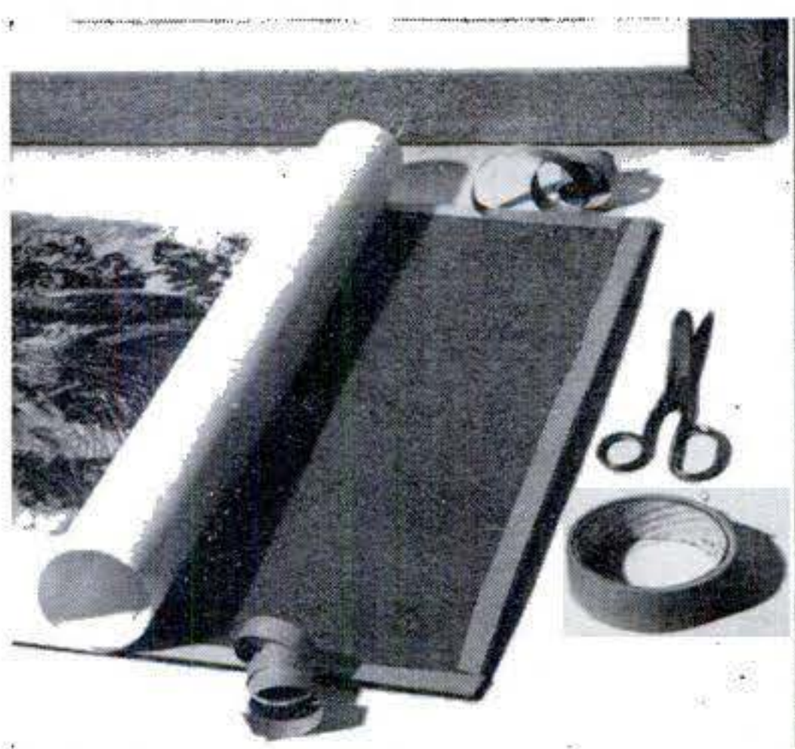
follow uneven surfaces, giving an excellent bond. A micro-thin film, on the other hand, provides the closest positioning of one smooth surface against another with a minimum of thickness build.

Tape characteristics. The resistance of DC tape to common stresses is similar to that of other adhesives, but it has a combination of characteristics rarely found in glues and cements we use most often.

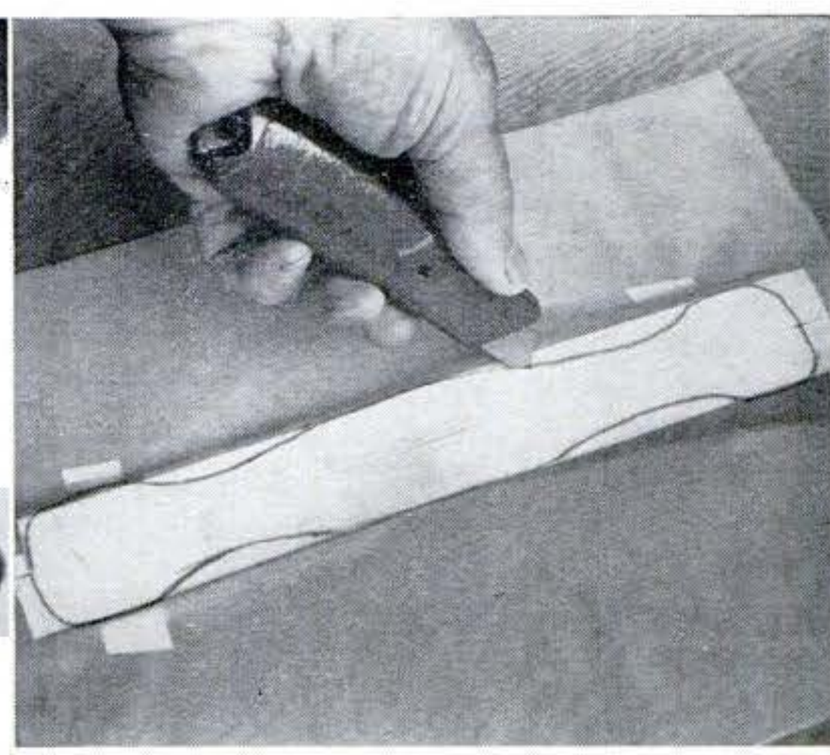
- Brittleness is just about zero. A joining will rarely come apart because of shock.
- Pull is excellent. In many combinations of adhesive and backing, joint failure would disrupt a film which, although it might tear easily, would resist tremendously being split between faces. Resistance to pull is greatest when the joined materials are smooth and plane, thus providing 100 percent contact.
- Shear is less than with standard adhesives, particularly under prolonged stress.
- Resistance to peel is not great. This is not of great significance when the materials joined are rigid or even moderately stiff. On the other hand,

[Continued on page 124]

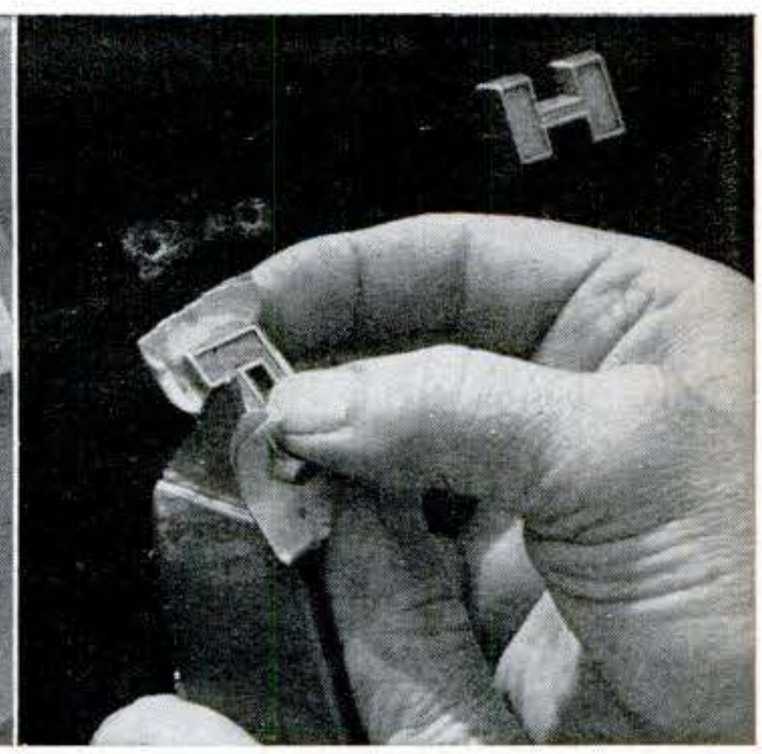
Industry uses double-coated tapes, too. How reflectors and car names are taped to new Fords is demonstrated here on glass



Tapes do not wrinkle paper as most liquid adhesives do. Therefore, you'll find them great for mounting prints for framing. Note taped edges in the photo above.



To replace a worn luggage handle, pattern drawn on tracing paper is taped to leather —and is held nonskid—while the leather for new handle covering is cut to shape.



When mounting small objects, apply tape to the back, trim excess, remove parting strip, and position. Press down for a few seconds until the adhesive grabs.

Action at Your Fingertips

Touch Switch does many things for you—and then opens the circuit after a certain interval

By WILLIAM J. HAWKINS

Just touch the plate and this versatile switch knows you want action. The Touch Switch can take the place of any switch in your home, car, or boat, actuating a device by "sensing" your fingertips. Then, a moment or two later—whatever duration you've set it for—the contacts will open, automatically resetting the circuit.

You can build the switch quickly and easily. But first you must make a printed circuit, using a new kit.

The Touch Switch operates off its own battery supply. A variable time-delay circuit lets you preset the ON state for a certain amount of time.

- You can use it as a doorbell button that will automatically lock on and give the bell a good ring—no more annoyingly short blasts.
- Use it to control the outside lights on your garage, or your car's headlights, and they'll remain lit until you've reached the house.
- Connect it to the speaker of your TV and kill those commercials for 60 seconds. The Touch Switch will turn the audio back on for you.
- You can even use it as a timer to limit things from a three-minute phone call to a two-minute egg.

These are only a few ideas for the Touch Switch—there are plenty.

We designed the circuit using different-size components intentionally to check the versatility of a new

Making the PC Board

A printed-circuit board, no matter how complicated the circuitry, begins as a phenolic, glass-epoxy, or glass-polyester strip with a thin layer of copper covering the entire surface. Electrically, it is simply one flat, wide wire.

If you were to divide the copper in two by peeling a strip down the center, you would in effect create two separate electrical paths. The more you divide the copper, the more individual circuits you can create. By removing all but a strip of copper joining two points, you have connected them electrically.

This is the basic idea behind all printed-circuit boards. Rather than peeling the unwanted copper from the board, however, it is eaten away by a very mild acid called etching solution. First, of course, you prepare the board so only the unwanted portion of copper is removed.

After drawing or copying the desired layout on a piece of paper, transfer the outline to the copper side of the board, using carbon paper and a centerpunch to mark the component lead holes. You can trace the conductor paths or sketch them directly on the copper with a pencil. Apply a "resist" over the outline and the board is ready to be etched.

A resist is merely a material that offers resistance to etching acid. Wherever there is resist, the copper will remain; where there isn't, the copper will be dissolved.

Two types of resist are included in the GC kit. One consists of pressure-sensitive pads and tape. Simply sticking to the copper, they make up the component lead terminal pads and circuit interconnections. They must be pressed firmly onto the copper surface to insure good adhesion. The tapes should slightly overlap the pads so that no breaks will occur during the etching process.

The second method available to you is etch-resist lacquer. This is simply painted onto the board over the outline with an artist's brush. Using this method you may, if you wish, dispense with the carbon-paper transfer by cutting out the pattern and using it as a template. As the lacquer dries, watch for pitholes or splits, and touch up as needed. When the lacquer is dry, the board is ready for etching.

The etching process takes only 10 to 20 minutes and should be done in the plastic tray provided. With the copper side up, place the board in enough etch solution to cover its surface completely. Using a plastic or wooden stick, you can agitate the board in the solution to speed up the etching. (Although it's a mild acid and can be washed off with soap and water, avoid contact with it.)

Continue soaking until all the unwanted copper has been removed, but do not over-etch. This can break down the etch-resist and dissolve a neces-

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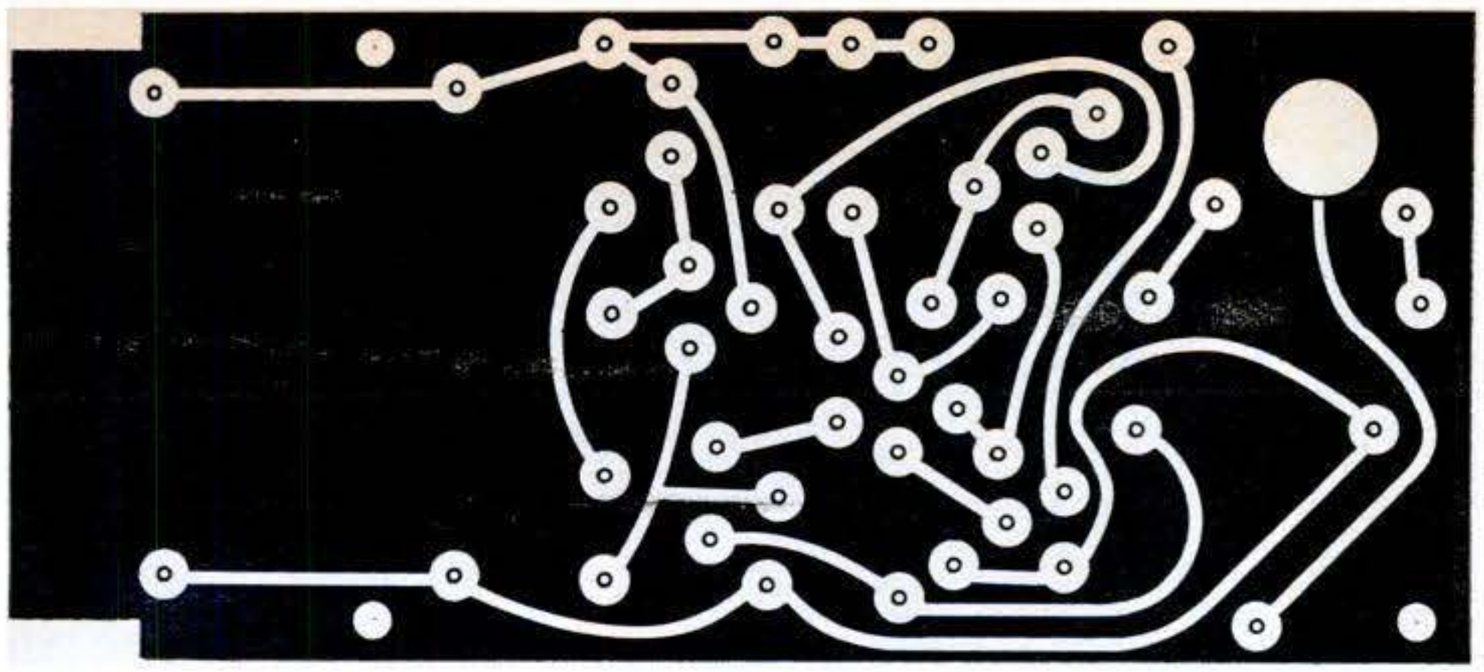
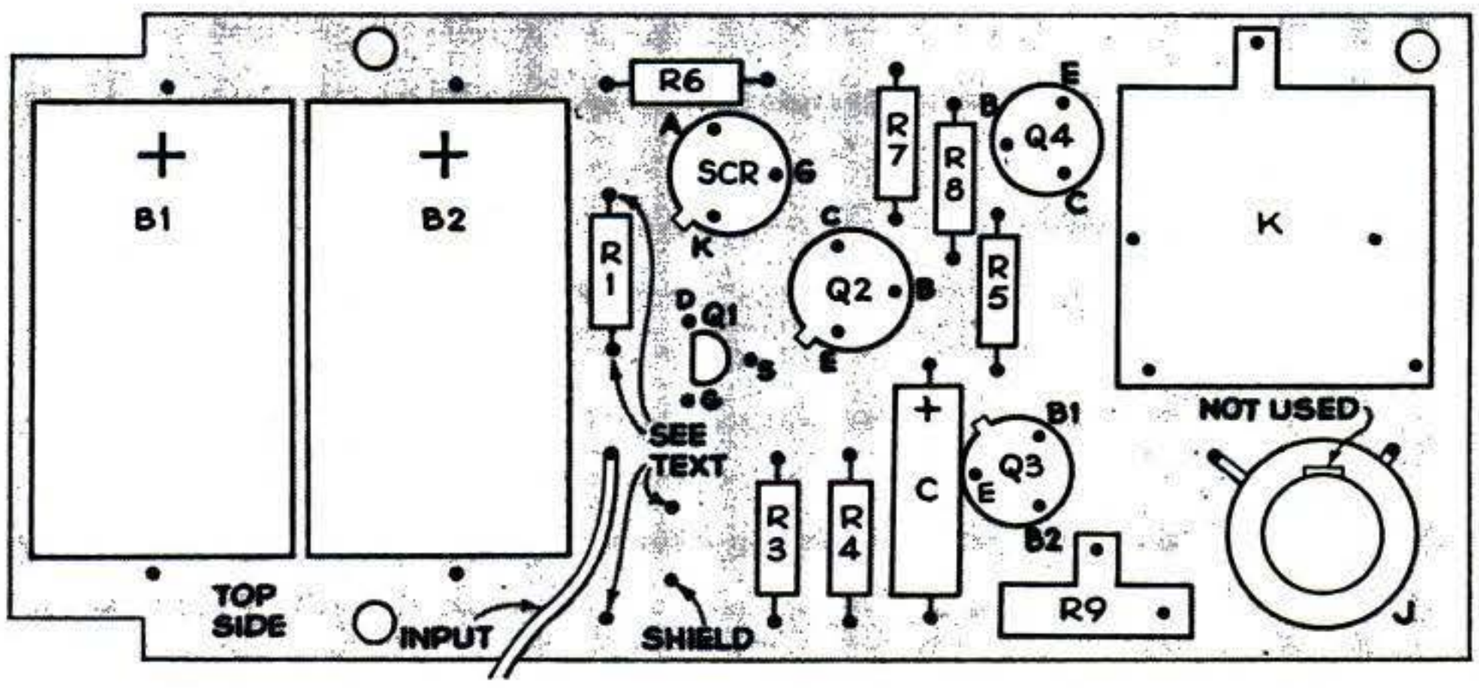
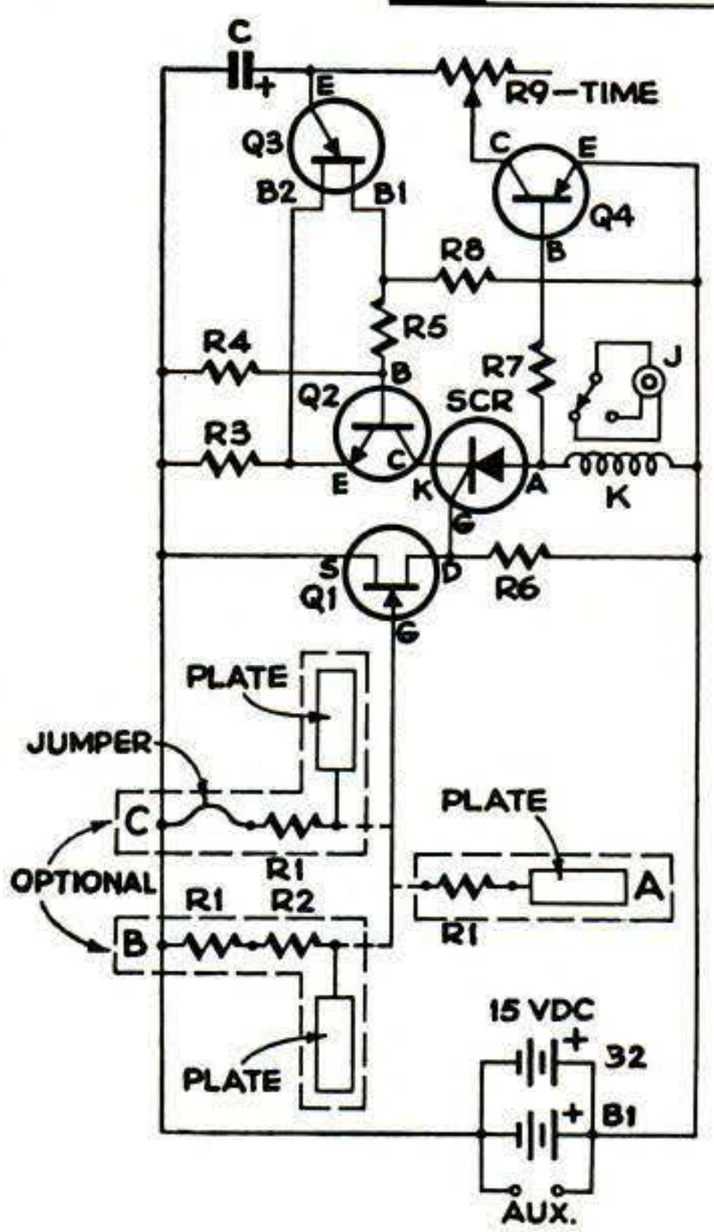






printed-circuit kit offered by GC Electronics. We found it very easy to use—and a lot of fun.

In the kit you'll find a set of printed-circuit boards, including the one for this project, and all necessary etching materials. You can obtain the kit from most GC distributors. A list of distributors is available from GC Electronics, Dept. PC50, 400 S. Wyman St., Rockford, Ill.

How it works. Body-capacitance circuits are, of course, not new, but we made an updated version with a little extra to make it more versatile.

The touch action comes from a field-effect transistor which "opens" and allows the silicon-controlled rectifier to fire. Voltage from the SCR closes relay K and allows C as well to charge through R9. When C eventually discharges through Q3, current is removed from the SCR, dropping out K and resetting the circuit.

Varying R9 varies the voltage charging C, thus affecting the reset time. Using the components specified gives you up to 15 seconds' delay, but this may be increased by increasing the value of C. You can go as high as 100mfd, which will put the time duration up into minutes.

Both the normally open and the normally closed contacts of relay K are connected to the output jack. This allows you either to turn an ap-

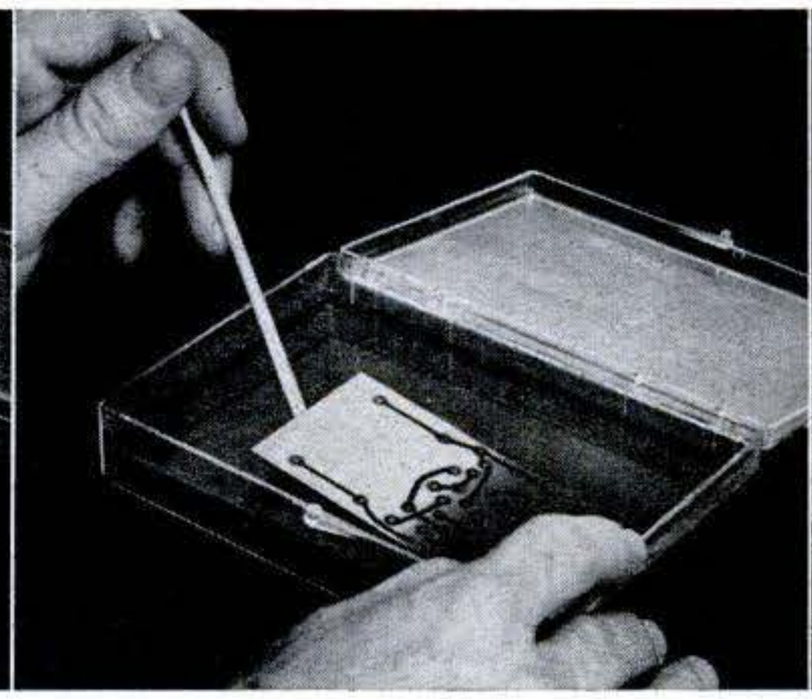
[Continued on page 116]

sary part of the circuit. Once the process is complete, remove the board and wash the surface with a coarse soapy pad, removing the excess acid and all etch-resist.

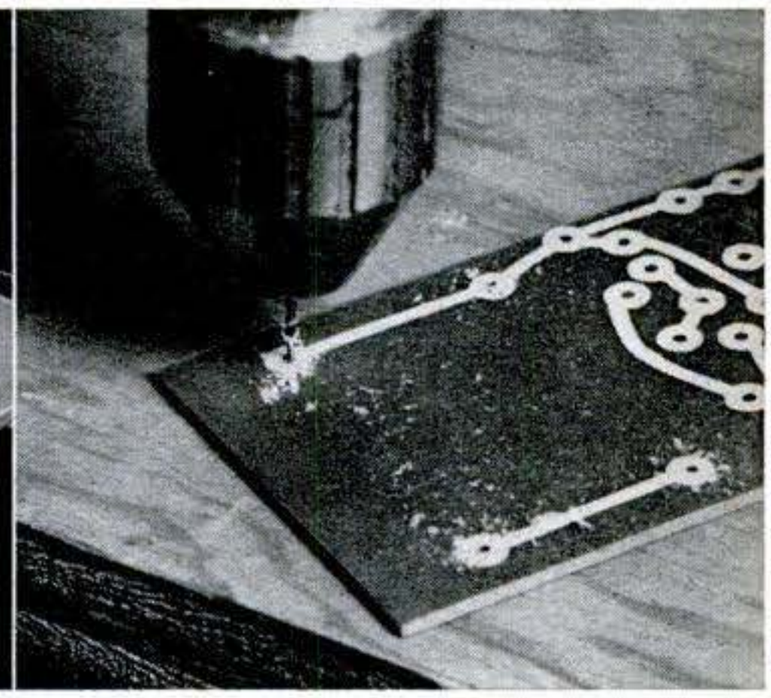
Complete the board by drilling the miscellaneous mounting holes as well as the component lead holes, choosing a bit that is just large enough to do the job.

Other methods of making PC boards are also available to you, but, unless you wish to do a large quantity of the same circuit pattern, this is the simplest procedure.

Draw or trace circuit on board and cover it with pressure-sensitive pads and tape. Alternate method: paint on resist lacquer.



Constantly check your progress to avoid over-etching. The solution turns nearly black toward completion of the process.



The drilled hole should be just large enough to accept the component lead. This will make the connection much easier to solder.

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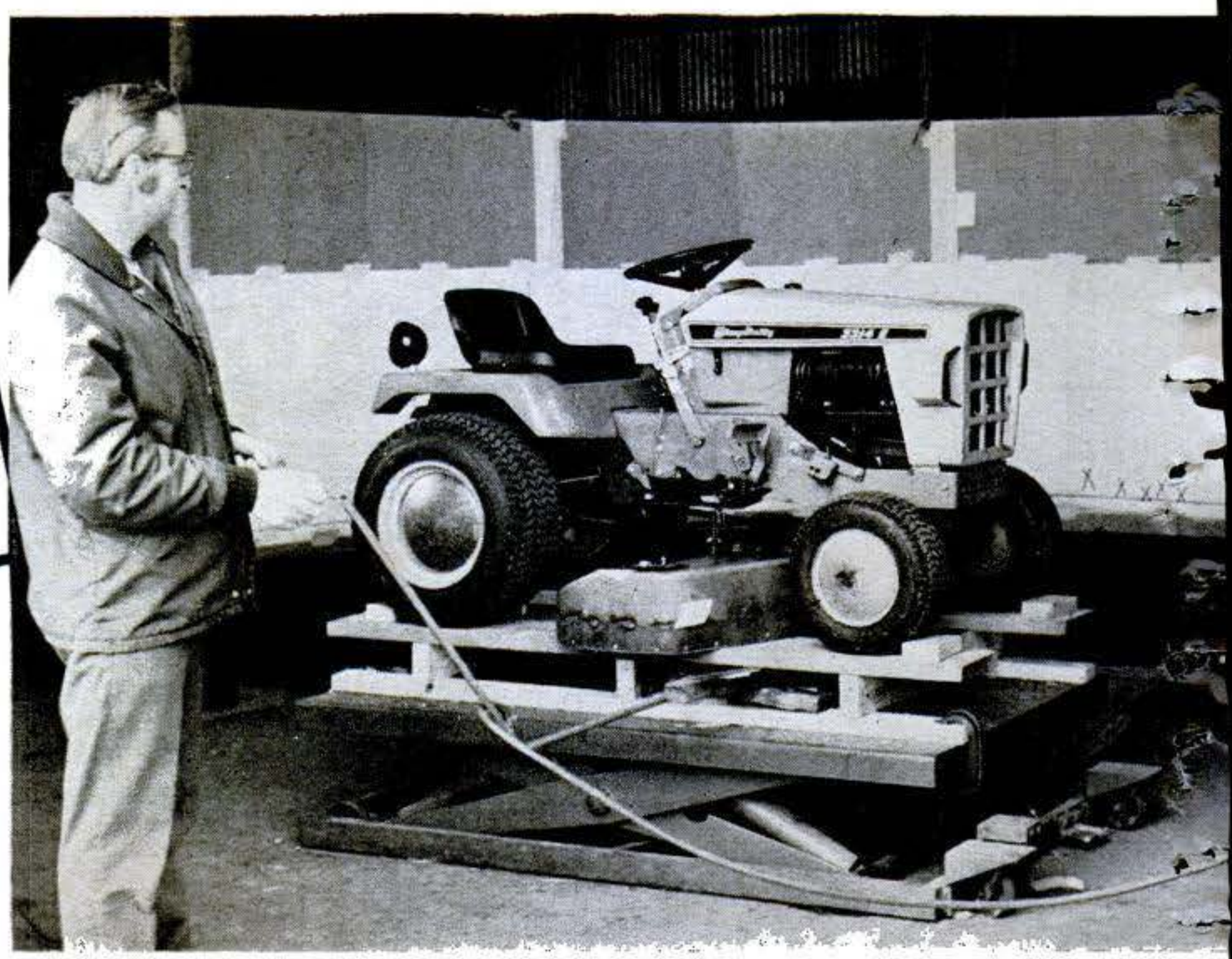

Behind this seal, which the Outdoor Power Equipment Institute permits only on mowers that have met certain safety standards, are rigorous tests like the one being conducted for Simplicity, at right. Steel nails are fed through air tube and thrown out discharge chute by whirling blades. Impact must be below specified line; X marks show test hits.

THE NEW MOWERS: They're

Ruggedly tested engineering advances should cut down on accidents. And the machines are more convenient

By E. F. LINDSLEY / *PS Midwest Editor*

Want to test your rotary-mower blade and housing for safety? It's easy! Just rig a one-inch, alloy-steel bar with a spring and trigger to pop up into the blade while it's whirling at full speed. Or drop 50 hardened ½-inch steel ball bearings through a hole drilled in the top deck. Injecting 300 six-penny, steel box nails into the blades and marking their impact on a target might be more fun. And then, maybe not. Such tests are dangerous, and even if they weren't, you'd be reluctant to abuse your mower this way.

Right now, however, mower manufacturers are conducting these rigorous tests, and many others, to be certain the mower you buy will be as safe as thoughtful engineering can make it.

Mower safety is a tough problem. A mower could be made so safe it wouldn't cut grass. Or it could be so cluttered with safety gimmicks that only a test pilot could run it. No one wants this . . . least of all the mower buyer.

Nevertheless, great strides are being taken in mower safety. Not all of these safety measures are visually apparent. Take that nail-injection test. I watched it briefly at Simplicity. What I saw was the result of hundreds of repeated tests to learn the subtle differences in chute and housing design that cut down to a scant few the nails that reached the target. That few, importantly, stay well within the prescribed limits of a safe trajectory.

This, of course, is just one small part of the total safety engineering now aimed at eliminating some well-known accident causes. Among them:

- Discharge of foreign objects from the chute or under edge of housing.
- Hands or clothing caught in belts, chains, or other moving parts.
- Loss of control—from confusion about which lever or pedal does what, and in which direction it should move, or from awkward placement of the controls.
- Tip-overs, collisions with fixed objects, runaways—caused by poor steering controls, shoddy steering linkages, ineffective brakes.
- Cuts, from hands or feet introduced into the blade path.

In addition to the target test and chute configuration, a great deal is being done about ejected foreign objects and danger to hands or feet from the blades. Toro's new Guardian has a guard encircling the blade tip's travel arc at the rear, and also a trailing hinged shield to trap and stop any object ejected rearward. Moreover, this shielding should almost put a stop to foot injuries resulting when a mower rolls back downslope, or the operator slips and thrusts a foot under the back of the mower.

Another feature of the Toro is a husky deflector bar partially bridging the chute outlet at ground level to deflect thrown objects downward. The same bar should discourage all but the most foolhardy and persistent efforts to insert a hand into the discharge chute. John Deere, a newcomer in the walk-behind mower field, boasts similar safety features. AMF's orange-painted, top-of-the-line models also have an impressively sturdy hinged flap or "toe guard" at the rear. Lawn-Boy offers the same concept, plus rollers, as an accessory called a "safety escort."

Another foot and ankle protector is the front, right-angle discharge on Simplicity, Lawn-Boy, and International Harvester walk-behinds. When used without a bag, the operator's arc of safety behind and to the right is expanded greatly, especially when using the nonchute side to trim under trees and bushes.

Engineering with foresight. Engineering *can* prevent accidents that probably would never happen if we all used our heads. Good examples are the Bolens Orbit-Air mowers in the 22-inch size. Although the Orbit-Air is designed without a discharge chute and is intended to recirculate the grass cuttings until they are deposited as a fine mulch, Bolens provided a side opening with a hinged door for bag attachment. Thinking ahead, Bolens engineers realized that

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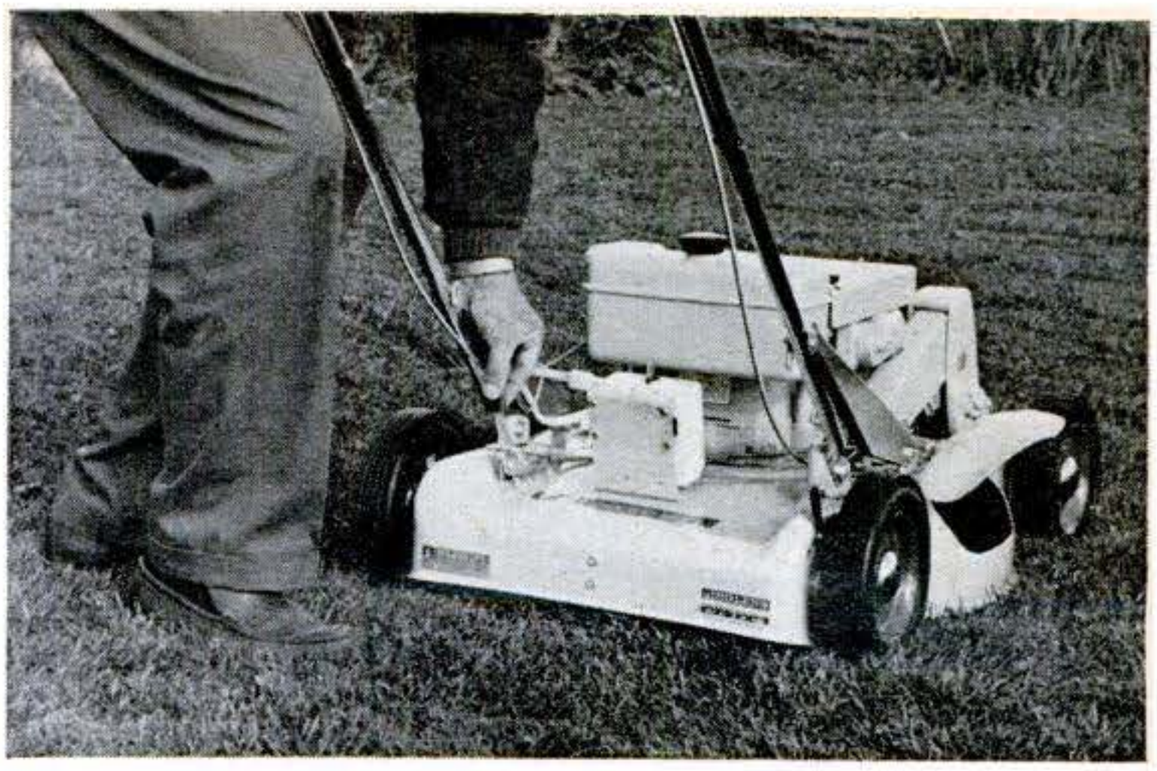

Bag chute opens only by control latch on opposite side of Bolens Orbit-Air; you can't open it accidentally while standing in front of discharge. Clutch and throttle are high up on handle.

Mower lift controls, well-marked positions, restricted chute opening, covered working parts attest to Massey-Ferguson safety.

Safer, and Easier to Use, Too

someone could position himself with his nose over the opening and open the door with the engine running.

To prevent such a dum-dum, the door is secured by a control which must be operated from the opposite side and rear of the mower, away from any possible discharge. This, plus mounting the throttle and wheel drive clutch high up on the handle, is part of a calculated plan to keep the user behind and clear of the business area of the mower.

Control position is important. After testing and trying a great many mowers, I'm of the opinion that the Bolens concept of control position at the upper end of the handle is extremely important on front-drive, self-propelled mowers. True, clutch controls halfway down the handle make it easier and cheaper to build a folding handle. But the half-mast control requires the user to stretch and bend over the handle to flip the control. In doing so, he takes his eyes from the mower path. If he doesn't take his eyes away to see what he's doing, he risks not moving the control completely into neutral. The result can be that the mower sneaks up on you while you're busy moving the birdbath or garden hose.

Moreover, with front-wheel drive, the act of bending over the handles drops the wheels into ground contact and you must hold back the mower (scuffing the lawn) and fiddle with the clutch at the same time. A little thing? Maybe, but it's a hazard you'll

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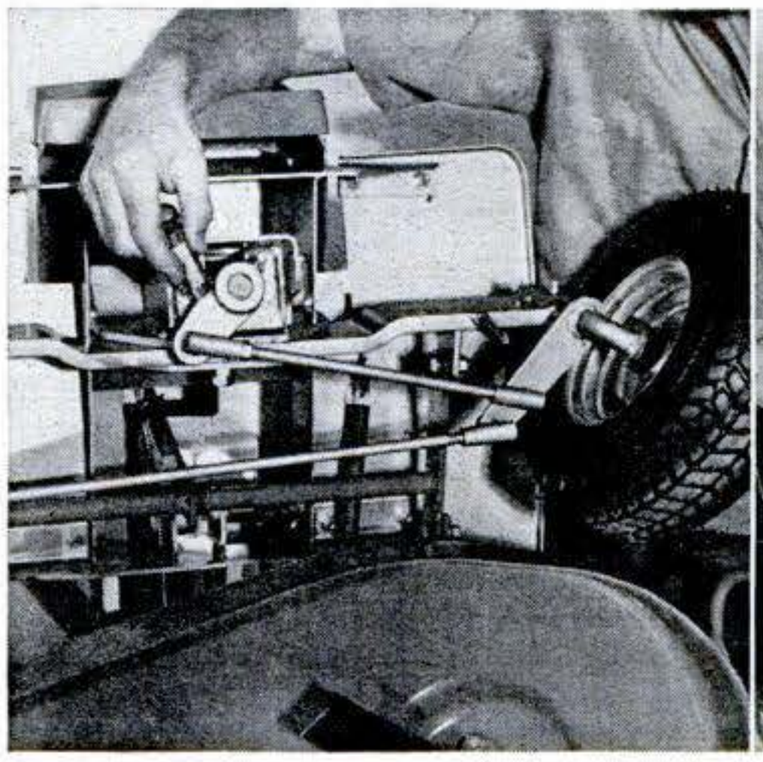

Magnet check proves steering arm is iron, not pot metal. Heavy ball-end rods, grease fittings on kingpins and wheels are other quality features on this Massey-Ferguson.

Electrical interlock under seat cuts ignition if you should fall off while mower is operating. Note also the solid, massive, well-labeled controls in the foreground.

Clear control markings are a feature of Hahn's LTD riders, along with excellent steering leverage and built-in tip stand. Note the OPEI seal on the top of the chute.

Gas-tank filler on Lawn-Boy is well placed to keep dribbled gas from exhaust. Steering yoke and very solid front end testify to importance manufacturer gives to steering.

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dance the tango with many times each summer if you buy a mower with a half-mast clutch. Good examples of other makers who avoided this trap: Atlas, Pennsylvania, AMF, Toro, and John Deere.

What about riders? Important as controls are on walk-behinds, they become a vital safety ingredient when you mount a rider or tractor. You are now committed, short of an extremely dangerous "bail out," to going where and at whatever pace the mower travels. There is nothing funny about edging a rider in tight under a tree, shifting into reverse to back clear, only to find you aren't in reverse at all and you've clotheslined yourself on a branch, raked your scalp on thorns, or caught an eyeful of evergreen needles.

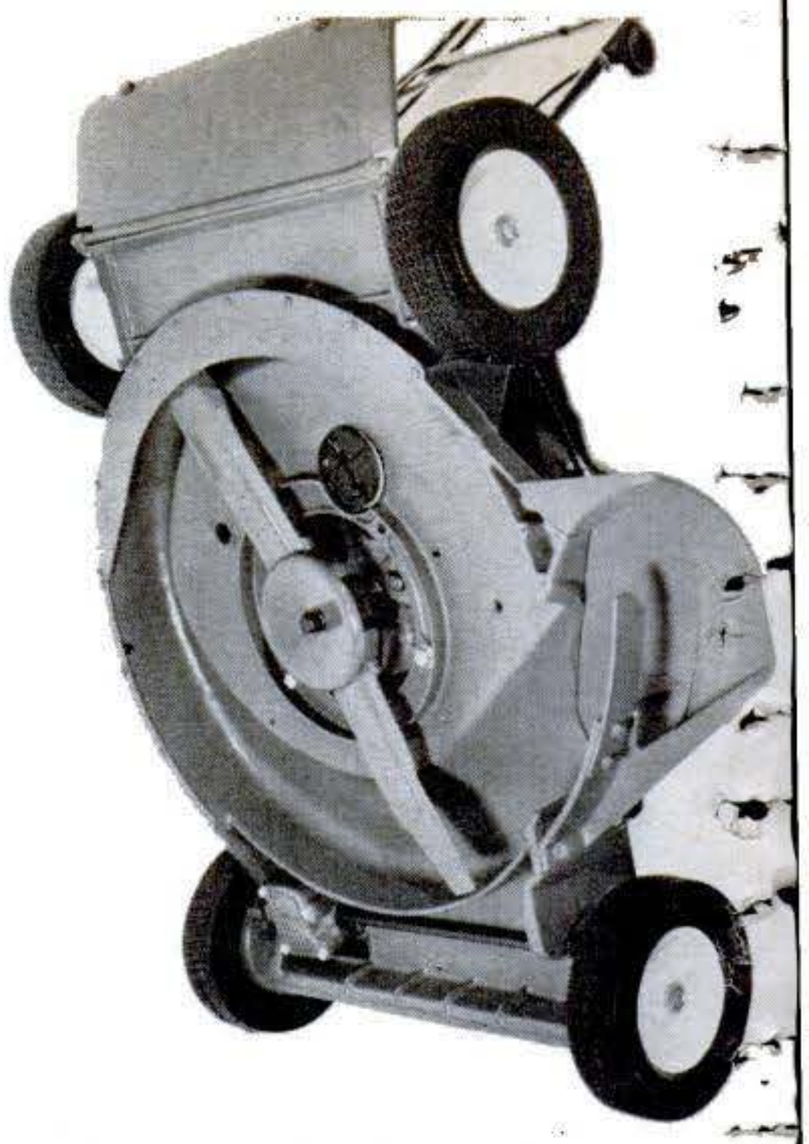
The number of potential hazards in improper controls covers pages and pages in a booklet of recommended practices circulated among mower company design engineers. Condensed and freed of the meticulous, almost legal, engineering wording, some of these common-sense stipulations on handles and pedals are:

- Direction of movement shall produce an expected and consistent action of the machine.
- Controls must be of adequate size and must provide adequate hand clearance.
- Controls must be identified for *both* purpose and direction of movement without reference to an instruction manual or trial-and-error.
- Controls should move forward for "fast," rearward for "slow."

How can you tell if the designer of the mower you're thinking of buying has done his homework? Here are some tip-offs:

- Seat yourself in normal operating position. Each control and lever should be instantly available to foot or hand without stretching, reaching into hazardous areas near drive chains or exhaust pipes, or craning your neck to see it.
- Identify the controls and what they do. They should be spelled out by durable, large-letter labels completely readable from the driver's position.
- Note whether the direction of movement, for forward or reverse, up or down, engage or disengage, fast or slow, is clearly indicated by an arrow or letters.
- Look for a table of basic operating instructions. Can you read and understand it clearly without guesswork? Could your wife grasp the important points, especially those relating to hazards?
- Are the control handles massive enough for solid gripping? Lean on them. A collision, tip, or bump might cause you to throw your weight on them. Take a look at the handles on Huffy's riders for examples of good practice.
- Are the controls gated or marked with detents you can easily feel? Some multispeed rider transmissions are grossly lacking in positive detent positions.

The new Massey-Ferguson rider illustrated is an excellent example of solid, massive, well-labeled controls. Hahn-Eclipse and their LTD riders should be commended for fine control identification. And on the John



Protective semicircle plus trailing rear shield close the back of Toro Guardian to thrown objects or slipping feet. Discharge bar makes it hard to stick in a foot or hand.

Throttle and drive clutch are where they ought to be on this two-speed front drive from Atlas. The toe guard and extended chute will keep your feet out of the blades.

Thorough instructions appear on panel behind the steering column of this new seven-hp rider from John Deere. Elaborate chute outlet is designed to minimize discharge of any foreign object.

Height-adjustment lever on off-discharge side of this AMF is man-sized and sets all four wheels with one operation—a great improvement over individual wheel locks, our expert points out.

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Self-propelled mower, new from John Deere, has rear blade guard under housing, trailing flap behind; interlock to cut ignition when bag is removed. Wives use it in safety.

Right-front discharge on this Simplicity increases safe area when mower is used without bag for trimming. Outlet slants down at top to reduce trajectory of thrown object.

Rear-drive walker from International also features right-front discharge. In addition, it has a safety clutch control which drops out if released. Note top-of-handle controls.

Deere new "57" rider, a legible, well-illustrated, and complete instruction panel between the foot plates really tells the story.

Built-in interlocks are great safety helps. Toro's Guardian, for example, cuts the ignition if anyone tries to remove the bagging chute or opens the deflector cover with the engine running. On Massey-Ferguson riders, a switch under the seat cuts the ignition if you fall off the mower. Look for more and more interlocks to come.

Can you steer it? The steering is not good on all riders. Best advice here is "try before you buy." Unfortunately, the mental processes of the buying public tend to equate steering a mower with steering a passenger car. Market-sensitive mower makers have been chagrined when good-steering mowers with tillers didn't sell, and poor-steering mowers with steering wheels did. In self-defense they opted for style over good engineering. If your lawn is tennis-court smooth, any old steering system will do. But if your lawn is rather rough, as most home-tended lawns are, you may find the shaking and twisting of a steering wheel (feedback) makes mowing miserable even though you have an otherwise excellent machine.

Unlike a car, a mower that's to be maneuvered around trees and plantings requires very quick steering—a short ratio. Unfortunately, a front wheel dropped into a small depression around a tree or a signpost, or brought too close to a dropoff, will feed back a sharp twisting action and pull the mower into the tree or over the embankment. Without the ratio of automotive steering you lack leverage to hold your course. Some mowers with less stylish tillers and yokes offer excellent steering. We repeat: If your yard has banks, drop-offs, pockets, or marked roughness, try before you buy—it can save you or one of your family from a serious accident.

If you're satisfied with steering performance, take a look at the steering mechanism. Good steering linkages have solid components of iron and steel. Better control rods are fitted with ball ends, not turned-up ends riding in punched-out holes in the steering arms. Obviously cost is a factor here. Since very few prospective buyers tip the mower up to examine the engineering of the steering linkage, there may be a tendency to skimp. Unless price is your prime object, take a hard look at steering.

Tipping the mower. It's a good idea to try this beforehand. Hosing out, or blade and belt service, all require you to get at the underside . . . safely. Many manufacturers are building in variations on "roll-bar"-type stands for space-saving rear-end storage. Massey-Ferguson, John Deere, Lawn-Boy (on some models), AMF, and Hahn-Eclipse build them in. If the mower you're appraising doesn't have a rear-stand feature, try lifting it up and ask the salesman how to keep it there without having it drop with a bang. If nothing seems feasible other than a stick propped rabbit-trap fashion, there must be something better on the market. Keep looking until you find it.

One way to be sure the mower of your choice has been safely tested is to look for the OPEI seal prominently displayed. This year, as part of a massive safety campaign right at the dealer level, you'll probably find a green tag with a picture of "Mr. Lawnmower Safety." On one side of the tag are nine no-kidding instructions on family mowing safety practices. On the other side you'll find affirmation that the mower has been independently tested—including nails, steel rods, and all—to A.N.S.I. Standard B71.1. "Antsi" (as the mower engineers pronounce it) is really the American National Standards Institute, an independent testing agency. Read the tag. It tells you that the mower:

- Has a restricted and guarded discharge opening.
- Has moving parts safely enclosed, and its handle (if a walk-behind) has an "Up Stop" device to keep it from going over center to let the mower nip your toes.
- Cutter speed has been limited to a safe maximum and the angle of discharge positioned to keep the operator area safe.
- The blade housing encloses the blade even at low position and the blade housing has passed the "sudden impact" (steel rod in blade) test.

These tests can prevent thousands of accidents. To take advantage of them, all you must do is buy a safety-tested mower and operate it with common sense. PS

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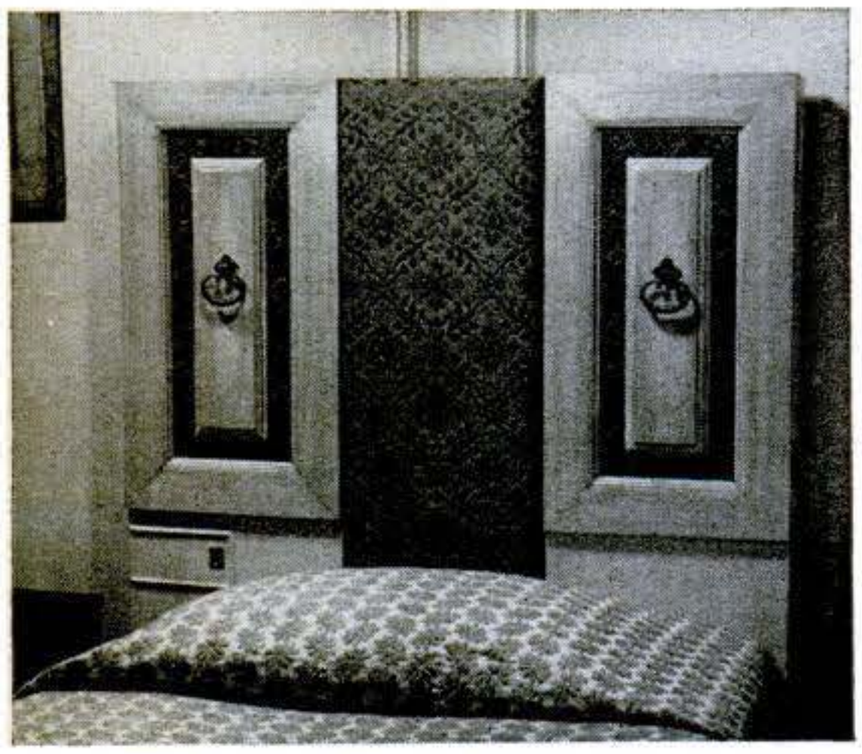
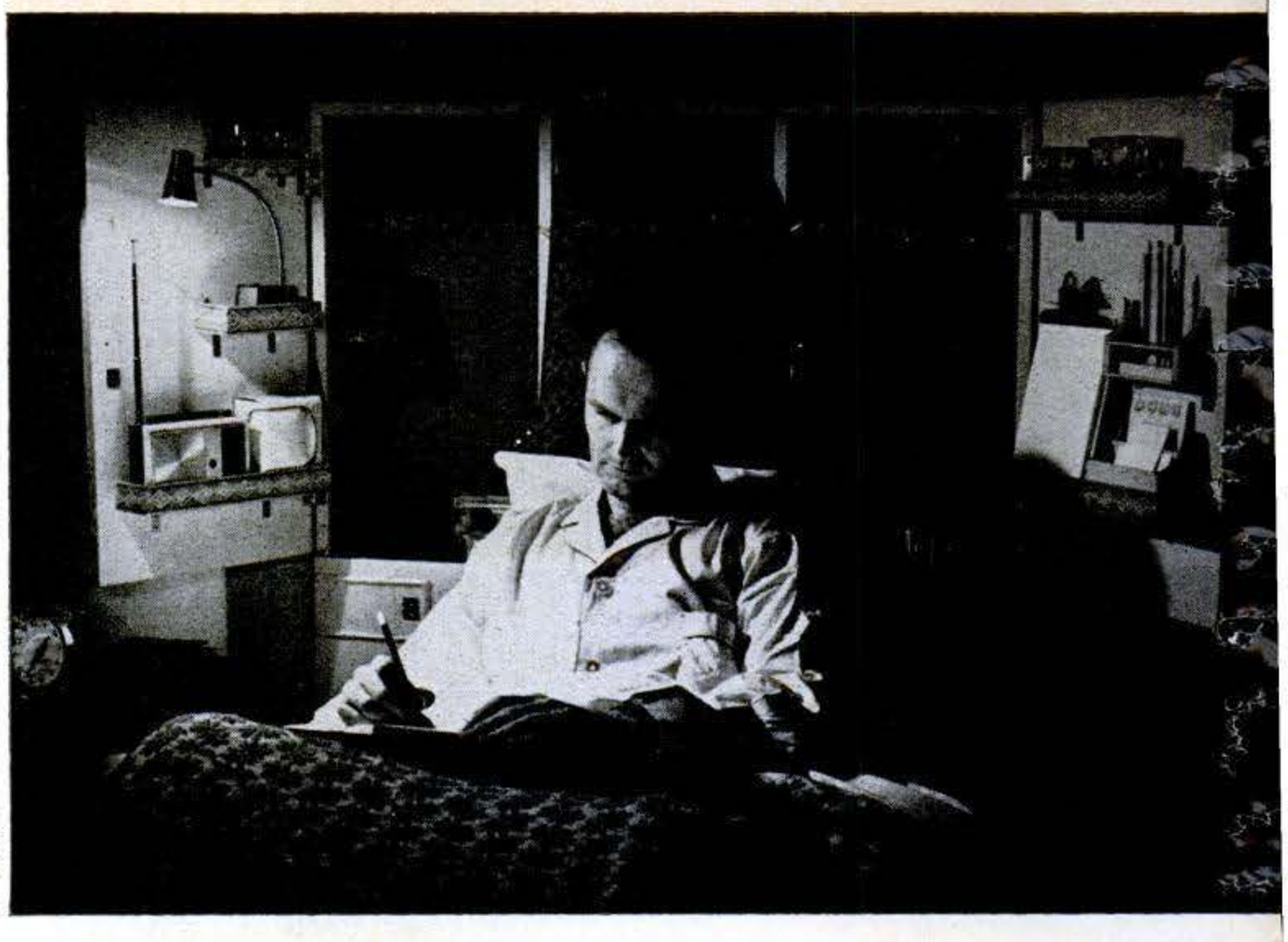


During the day, the headboard is an ornamental piece of furniture, giving no hint of the many work and reading advantages it offers a nonsleeper (see right) at night.



Headboard for Night Owls

Want to read, make notes, even record a dream? What you need is right at hand

By WILLIAM SILL

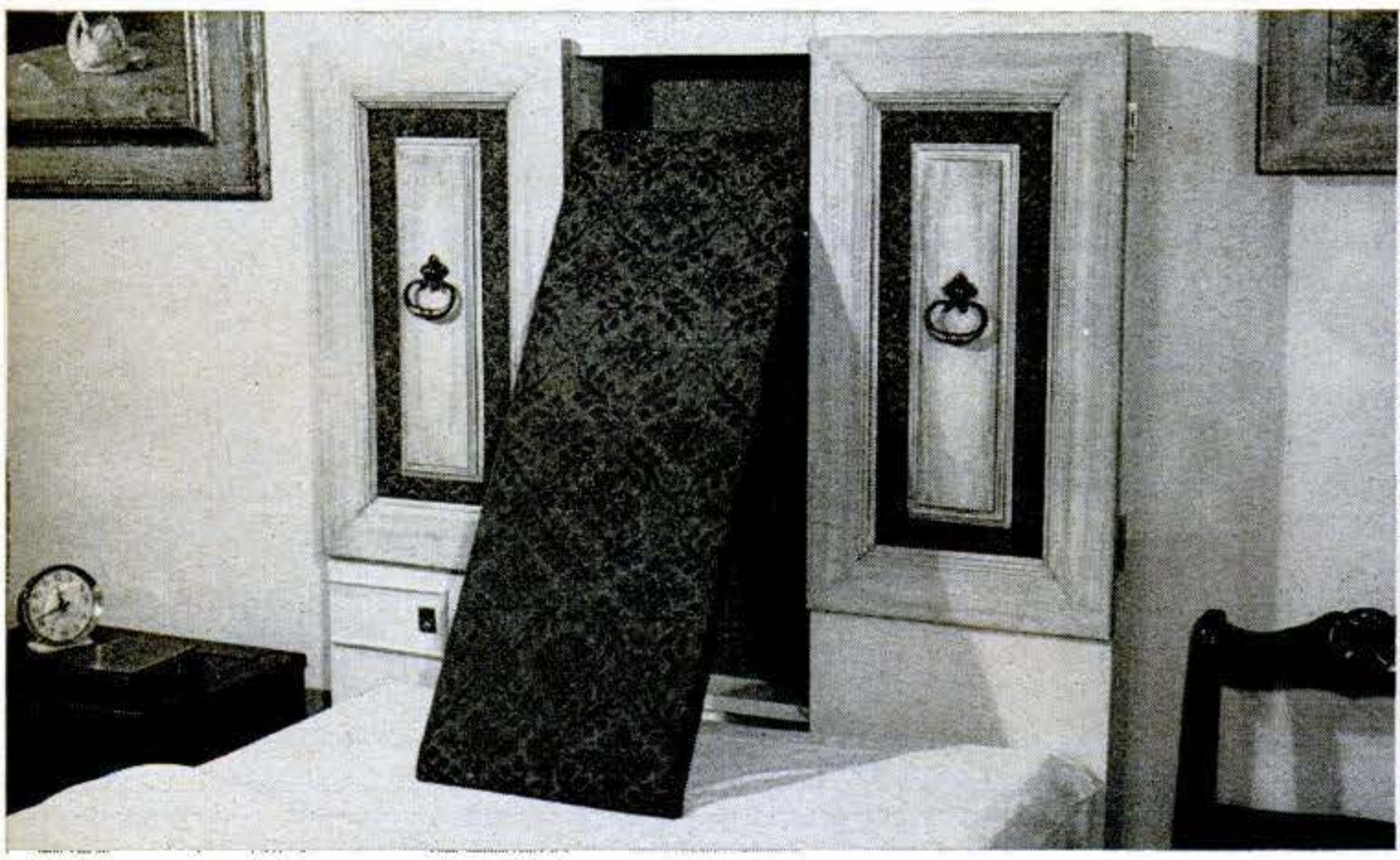
Here's a dream headboard for those who like to read or write in comfort during bedtime hours. Twin doors behind you open to place at your fingertips all the reading matter and writing materials you might want. There's even space for a small radio on one of the shelves.

The frame consists of one-by-four pine stock. All other wood materials can be ½" or ⅝" plywood, hardwood-surfaced for those panels that will show. Thin embossed wood molding was used around edges of the shelves to retain items placed there.

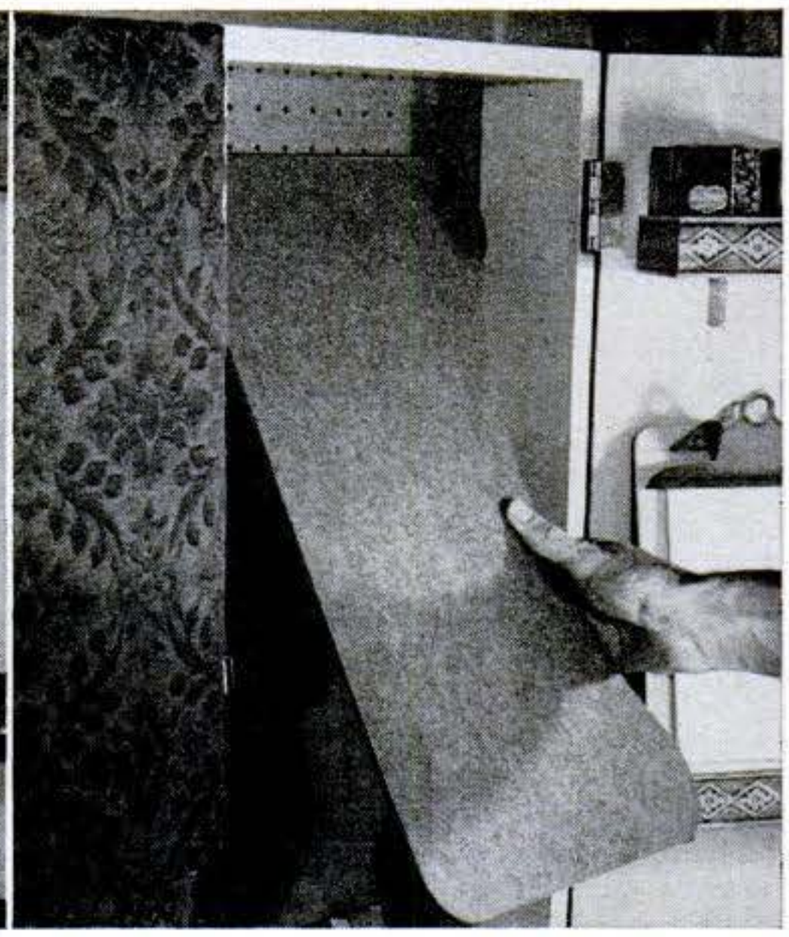
As seen in the drawing, the one-by-four frame was doubled at the floor and hardware was installed to take the side rails of a conventional single bed. This attachment could be omitted, of course, and the entire headboard fastened to the wall with lag screws. Then you would simply place the regular bed in front of it.

Pieces of quality upholstery material were stapled inside the door framing. Mitered molding around the inner edges of the frame pieces covers the staples and edges of the fabric. Matching fabric went on the face of the backrest.

Antique white paint was applied to the doors and shelf moldings, and matching off-white enamel to the frame and the lower facing. Brass pulls finish off the two doors. PS



A foam-padded backrest tilts out at a convenient angle as a ½" dowel across its top slides down in the retaining slots on each side. Adjust the backrest to suit your own comfort. A pivoting latch (see drawing at right) keeps backrest in its up position.



A writing board made of ¼" hardboard is kept handy in one of the compartments. It is 11" by 20" with inward curve on side.

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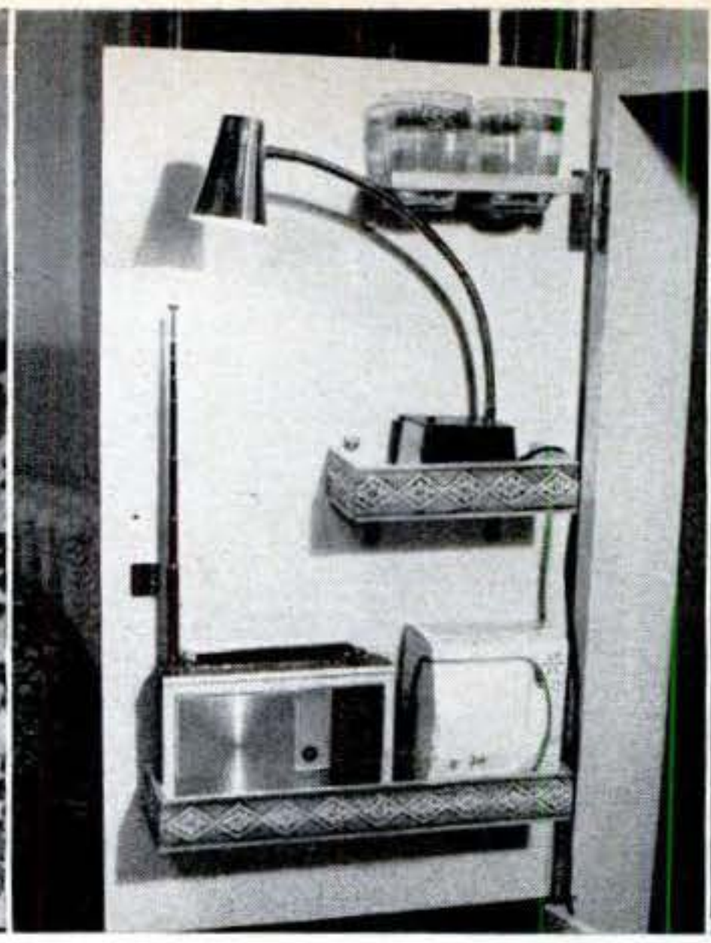
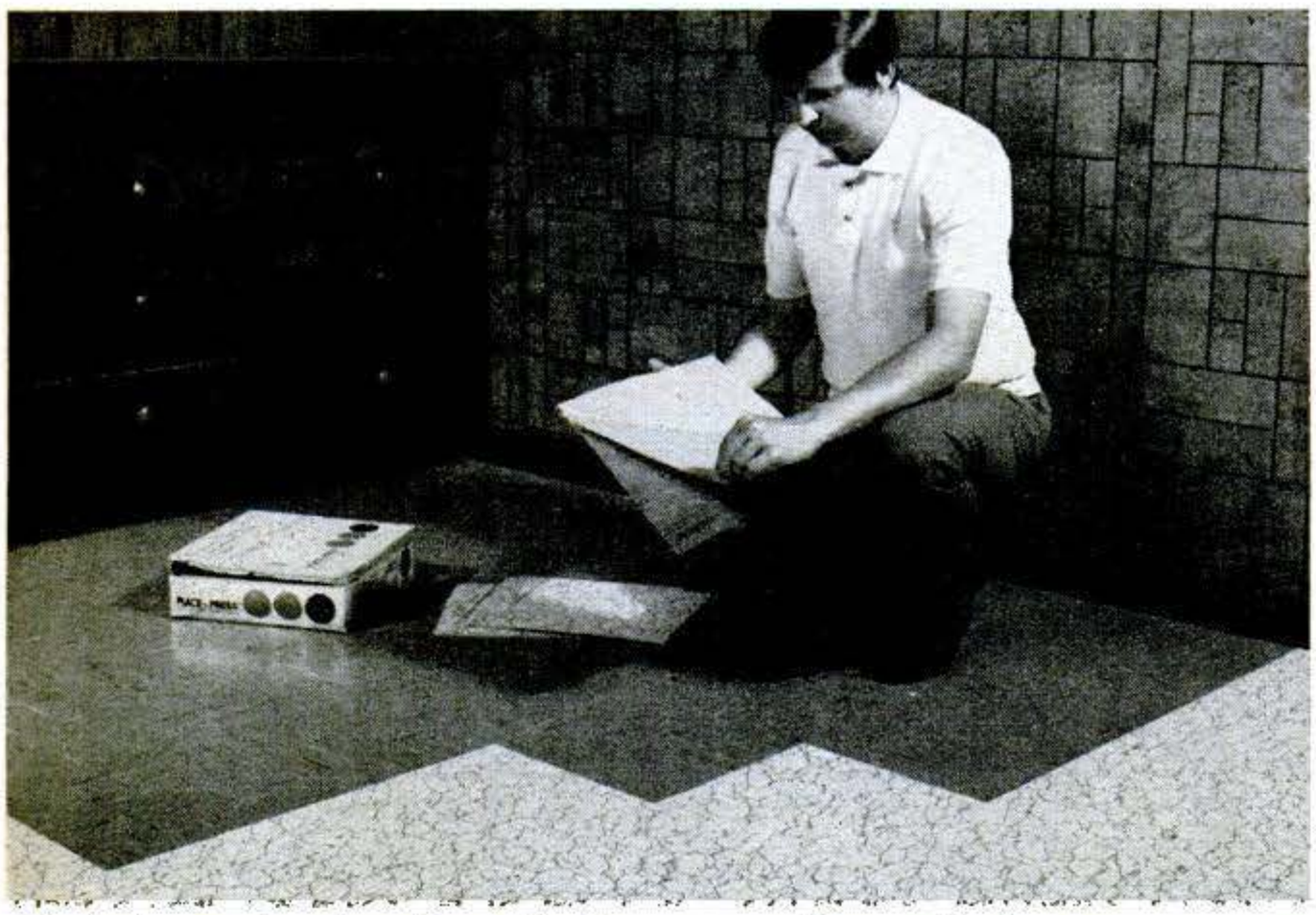
A small door in the headboard holds a shelf for an electric-blanket switch. The piece of wood cut out was surrounded with molding and hinged as the door.



Convenient shelves are attached inside doors with small brass angles. Arrange and dimension the shelves to suit your requirements. The retaining shelves have ½" plywood bottoms, surrounded with 1½" embossed wood moldings.

SINGLE BED WIDTH
13 3/8"
13 1/4"
13 3/8"
MITER
1" X 6" SLOT EACH SIDE
MORTISE FOR HINGE
2 1/2" BUTT HINGE
1 1/2" EMBOSSED MOLDING ATTACHED TO 1/2" BASE
BACKBOARD 1/8" PERFORATED HARDBOARD
11 1/4"
4 1/2"
OVERALL HEIGHT 58"
BACK REST
3/4" DOWEL 14 3/4" LONG
1/4" BOLT
1/2" PLYWOOD
15"
1/2" MOLDING
BED HARDWARE TO MATCH BED
25"
1"X1"X12"
3/4X1"X2 1/2"
REVOLVING CATCH TO HOLD BACK REST
DOUBLE 1X4
1/2" X 4" X 16" PLYWOOD
DOOR
1/2" PLYWOOD 13 1/8" X 33"
BED HEAD
1/2" X 3" PLYWOOD
UPHOLSTERY MATERIAL
1/2" X 15" X 27" PLYWOOD
1" FOAM RUBBER
UPHOLSTERY MATERIAL 9 1/2" X 21 3/4"

Wall-to-wall carpet is quickest of all. These are Wearathon self-stick tiles, laid just as they come from the carton—not even a backing paper to peel away.



Vinyl-asbestos has long been the favorite install-yourself tile; now it's easier to work than ever. Place 'n Press Exelon tiles have paper-masked adhesive back

Adhesive can be spread over old flooring to lay less-expensive service-gauge vinyl-asbestos tile using Tile-On cement. Work a quarter of the room at a time.

Four Ways to Lay a New Floor Over an Old One

It's never been easier to renew a worn floor. Recently developed floorings give you a broad choice of textures and patterns that you can install in a few hours—right over the old tile or linoleum.

We asked the Armstrong Cork Co. to lay four of their newest products over the same old resilient-tile floor (photos at left)—then we tried a couple of the systems in actual home installations to make sure they were as easy as they looked. If the original flooring is firmly bonded to the subfloor, you only have to clean the surface before you begin. To lay the carpet tile, you don't even have to strip off the old wax; the sticky foam-rubber back holds fine to a waxed floor. For the vinyl tiles, wax should be removed; and if you're spreading adhesive, it's best to go over the old surface with coarse sandpaper.

All patterns shown minimize seams, so the new surface appears to be in one piece. But don't line up seams with those in the old flooring. The new 12"-by-12" size makes the job faster than laying old 9"-by-9" tile. You divide the room into quarters with a chalk line and square, do a dry run in two directions (at right angles from the intersection) to see if you'll end up with awkward fragments along walls, then adjust centerlines accordingly. All tiles are easily trimmed with a utility knife or scissors.

A bonus with the carpet tiles is that each can be lifted for repositioning (to hide a traffic-wear streak) or replacement (if damaged with a cigarette burn or bad stain).

The self-laying seamless in the bottom photo is called Castilian cushioned vinyl (it has a resilient foam core) and comes in a variety of brick, tile, and stone patterns, each in a choice of colors. Quarter-round tacked along the edges keeps it flat with no need for adhesive of any kind.—*Al Lees*

Seamless vinyl comes 12 feet wide. Cut sheet roll to rough dimensions of room, lay it dry and finish-trim edges with a linoleum knife (left).

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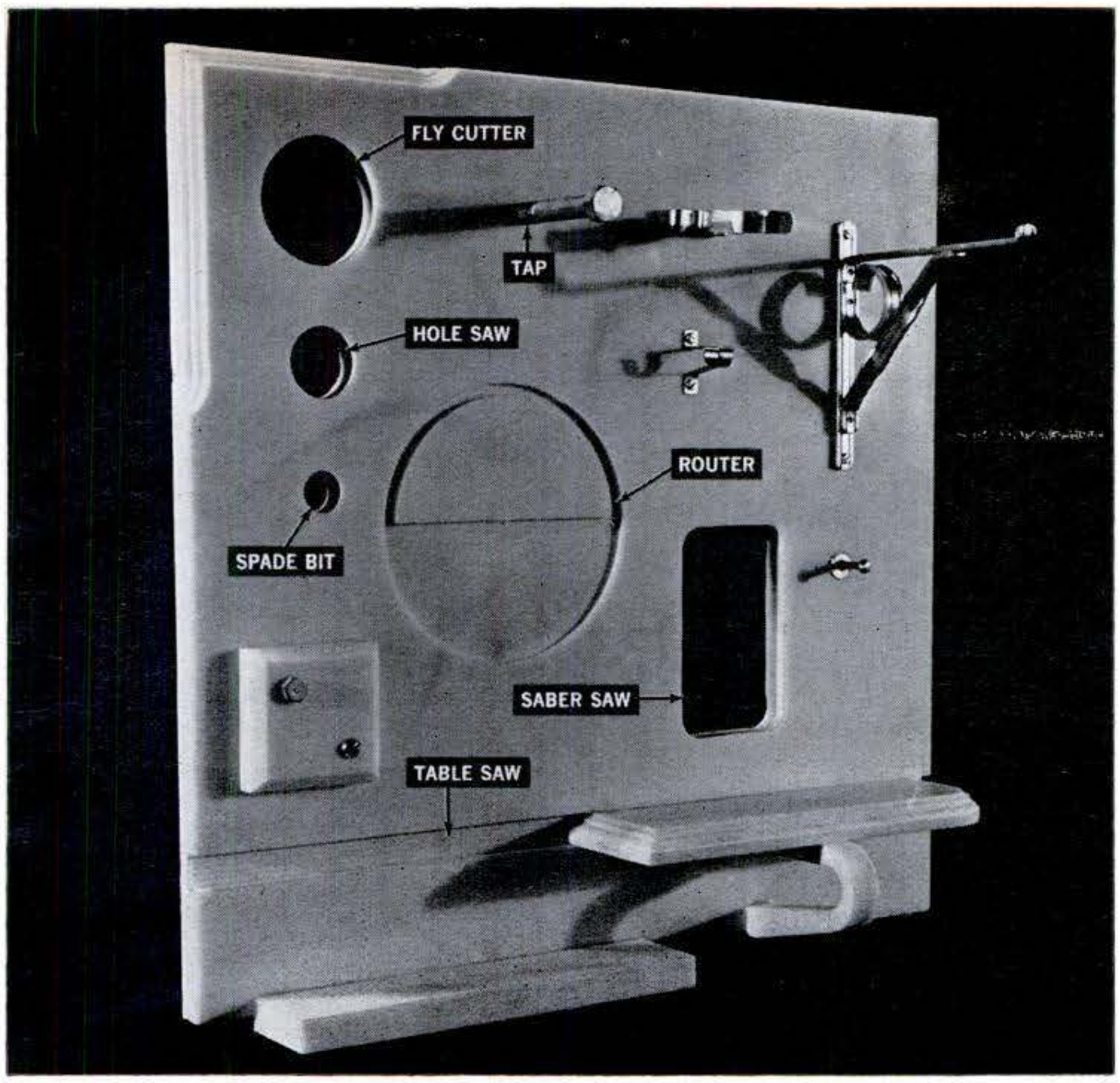

Tools you already own are all you need to work Corian—it handles like a dense wood.

How to Work with Corian

That new man-made marble will be at home in your shop—when you can get it

By R. J. De CRISTOFORO

Michelangelo would have loved this stuff. It has the look and feel of fine marble, but it's easy—and fun—to work with conventional woodworking tools. Add its super-practicality—toughness, stain and scratch resistance—and you've got one of the most exciting do-it-yourself materials ever made.

I'm talking about DuPont's new methacrylate material called Corian. Since Al Lees previewed Corian for you [PS, Aug. '70], DuPont's Buffalo plant has started large-scale production of the stuff in ¼" and ¾" sheets. If you live east of the Mississippi, your local building-supply dealer should just now be getting the sheets in stock.

Distribution to the West will come later this year. So this seemed a good time to run a few slabs through my shop to check it out on a strict, how-to-handle-it program.

To appreciate it, forget any preconceived notions about plastics. Regard it as a stone some genie has molecularly oriented for compatibility with tools you already own. Or think of it as a highly machinable, nonferrous metal that has somehow acquired opalescence—plus a built-in finish that can be realized on any smooth cut by buffing with a compound, rubbing with steel wool, even burnishing with your thumb.

How does it handle? Corian is heavy. You're not going to handle a ¾"-by-30"-by-96" slab of it as you would a piece of plywood that size. Overhang support supplied by outboard rollers or a helper is advised, especially if you are planning to

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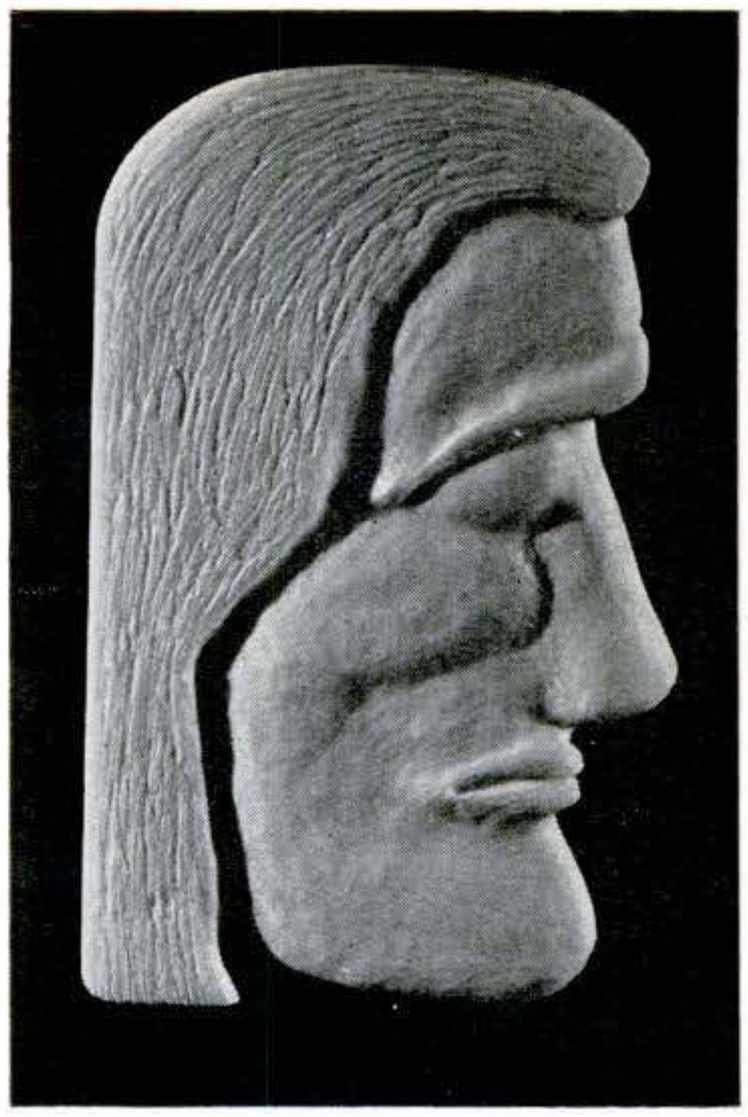
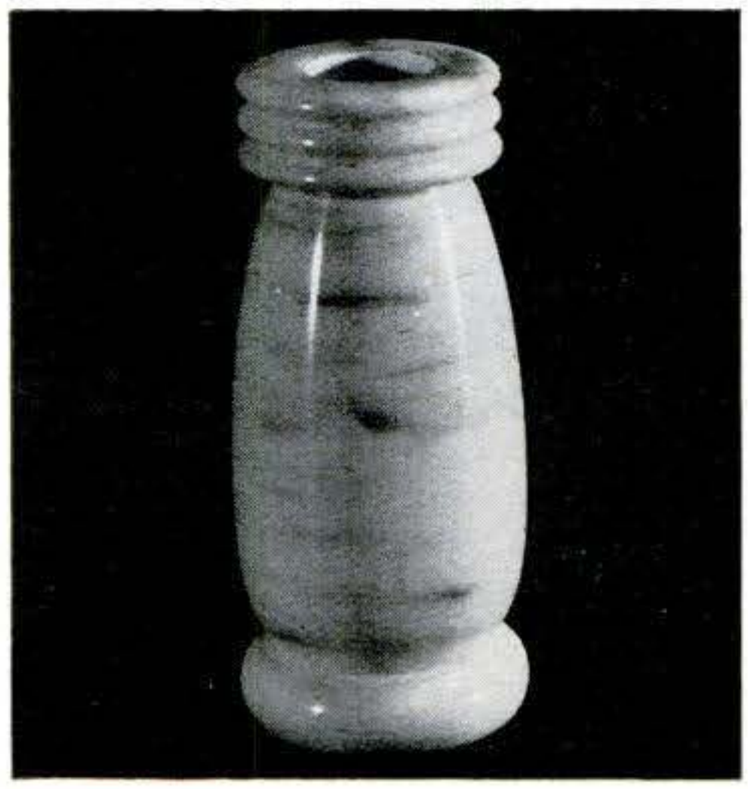


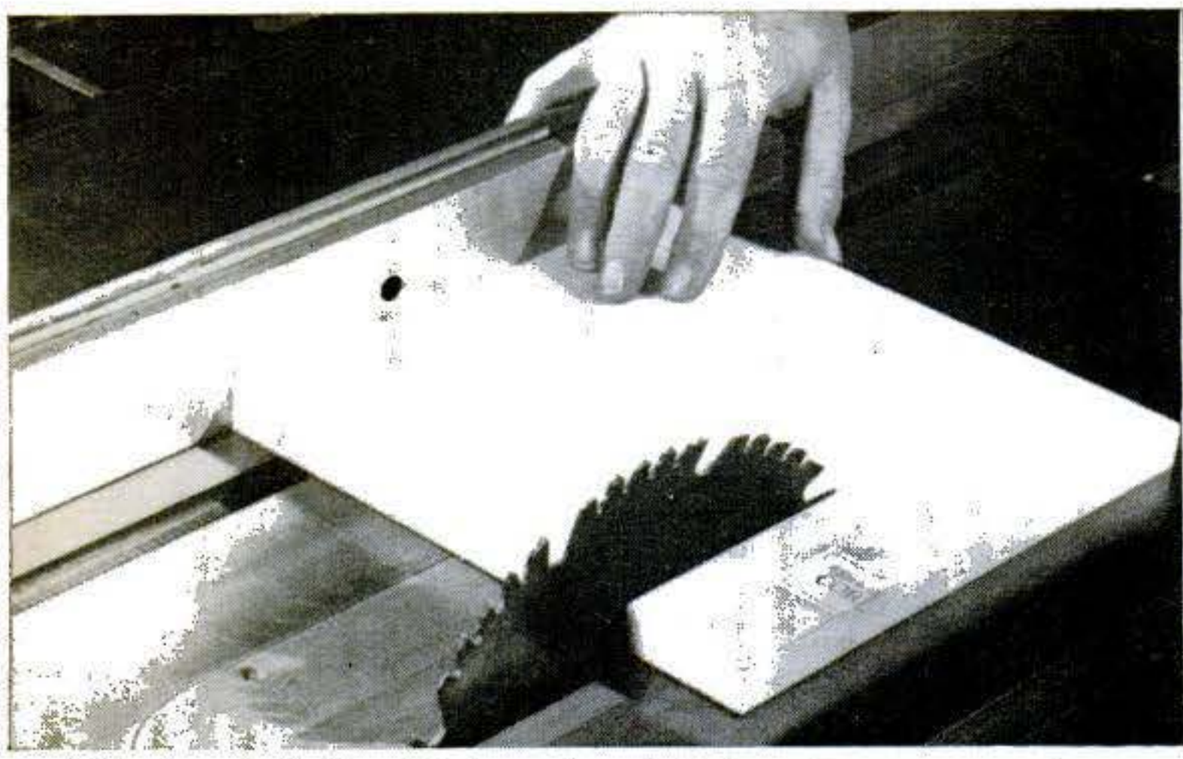
Corian just begs for carving: A flexible shaft and high-speed steel burr turned it into this sculpture. Rub with steel wool, then burnish with your thumb to finish.



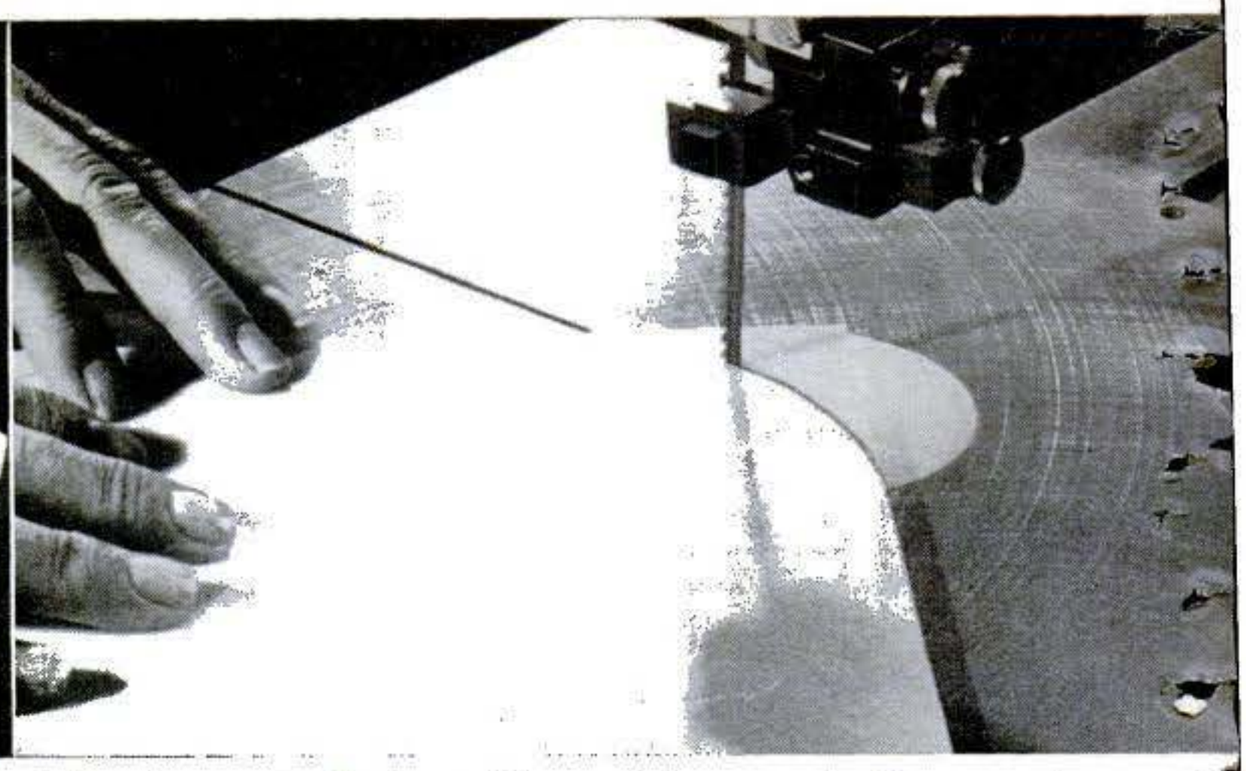
Corian turns like hard-rock maple under scraping action of conventional tools sharpened frequently. Polish in the lathe with very fine steel wool after sanding.

Spade bits—even big ones—will put you ankle-deep in shavings at regular woodworking speeds. Clamp the work firmly with a backup block below, use steady feed.

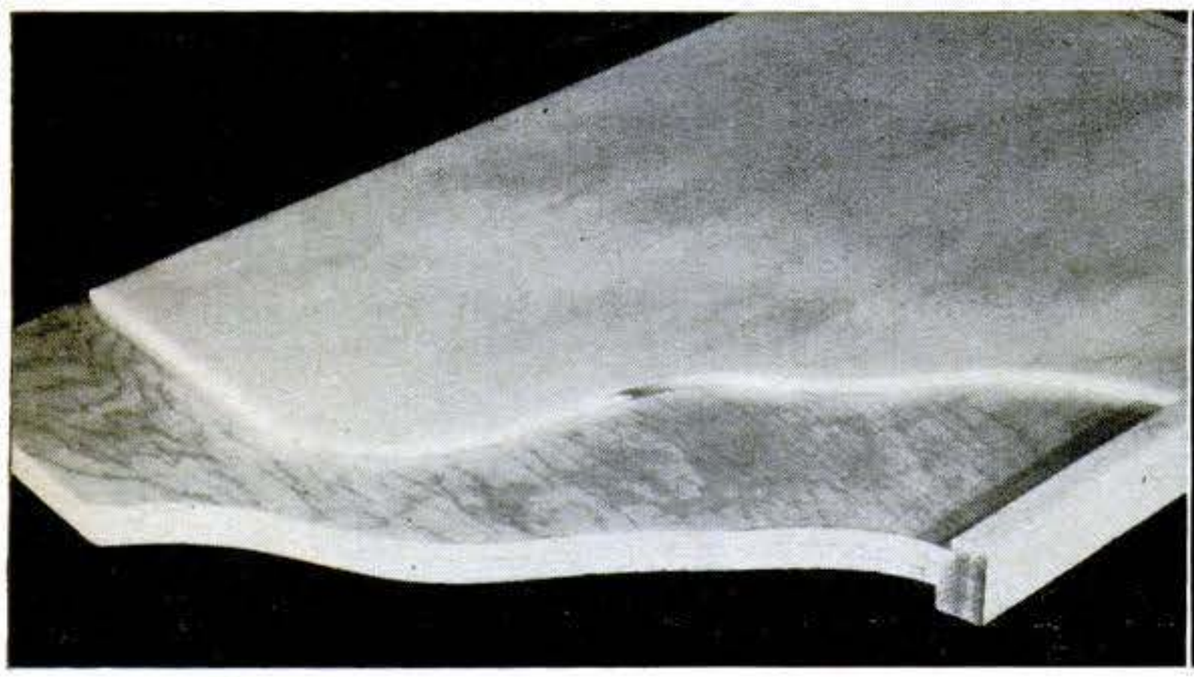
Your home-shop tools, the right techniques, careful working habits,



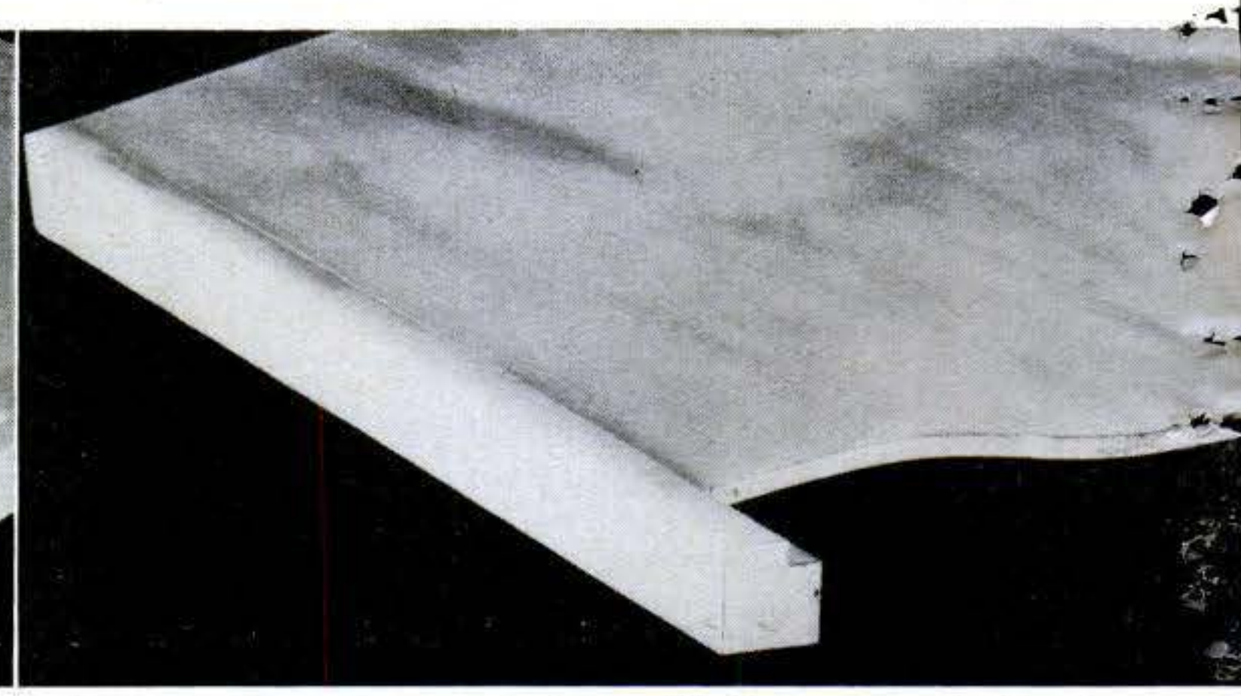
Carbide-tipped blade with lots of teeth is best for power sawing, but you can get by with untipped blades if you accept fast dulling. Use slow, steady feed, and high projection to prevent chipping.



A bandsaw cuts Corian with surprising speed. Cuts are clean, won't weld shut behind the blade—a problem with other plastics. An all-purpose blade—for woods and soft metals—holds up well.



Corian in ¼" thickness, laminated to ¾" plywood, can save you money on table- and counter-tops. Use contact cement or one of the paneling mastics described in the text. Wood molding or strips of ¾" Corian provide a heavy-look edge rim.



Rabbeted ¾" Corian epoxied to ¼" sheets gives look of a thick slab at a lower cost. Clear epoxy such as Devcon's EK-20 makes strong unobtrusive joints. A coffee table built this way is sturdy, but not strong enough to use as a bench.

make good clean cuts on a table saw.

Naturally this doesn't apply to smaller pieces, adequately supported by a tool surface; but even here, the weight of the material and its density requires extra feed pressure. This calls for stringent observance of safety rules concerning hands-to-cutting-tool placement.

You don't have to baby Corian, but it can be scratched; careless handling can result in nicked edges. The "good" surface is protected by a peel-off plastic film. It's best to leave this on for general handling, but not for intimate cutting or layout work. Clean, smooth tool surfaces and brushed-off workbenches are adequate protection against scratch gremlins.

Mark layout lines, hole centers, etc., with a soft-lead pencil.

The material doesn't chip or feather as wood products do, but it's still wise to regard the buffed surface as you would the good veneer side on plywood. For example—on a table saw or radial-arm saw, keep the good side up. With a portable cutoff saw, keep the good side down.

Sawing Corian. You'll get optimum results by working with a carbide-tipped blade—the more teeth, the better. But this doesn't preclude using conventional blades for an average-project amount of cutting—as long as you accept rapid dulling.

Avoid rip blades and combination blades with large, deeply gulleted teeth. Corian sands out in fine style, so perfection in saw cuts is not so critical. This minimizes need for a hollow-ground blade. A crosscut blade, with high projection and slow feed, does the job; if it's of heavy gauge, so much the better.

Rabbets and dadoes. Use the two-pass technique to form rabbets, and the repeat-pass procedure to cut dadoes. You can go to dadoing tools where the number of cuts you must make justifies the setup—but you'll still have to make repeat passes to achieve full depth on a wide cut. Cutting anything like a ¾"-by-½" groove in one pass is difficult. In all cases, feed should be steady but conservative. Forcing will result in a chatter that can gouge edges.

Freehand cutting can be accomplished with a cutoff saw, but best results are obtained by working against a clamped-on guide strip.

For bandsaw, jigsaw, and saber-saw cutting (even handsaws and hacksaws) you can do very well with conventional woodcutting blades of almost any type. Naturally, the larger the blade and the fewer the teeth per inch, the rougher the cut will be. For longer blade life, it doesn't hurt to choose metal-cutting blades. For much bandsaw work, those combination blades for cutting efficiently in either wood or nonferrous metals are good. Corian doesn't weld behind the cut like some other plastics do, so you work with a nice, open kerf.

Toothless, tungsten-carbide saber-saw blades work okay, but I became impatient with very slow cut-speed and discovered no advantage except in blade durability.

When doing internal cutouts, drill holes to provide the corner radii and then saber-saw between the holes. Round corners, especially on the ¼" stock, are better, structurally, than square ones.

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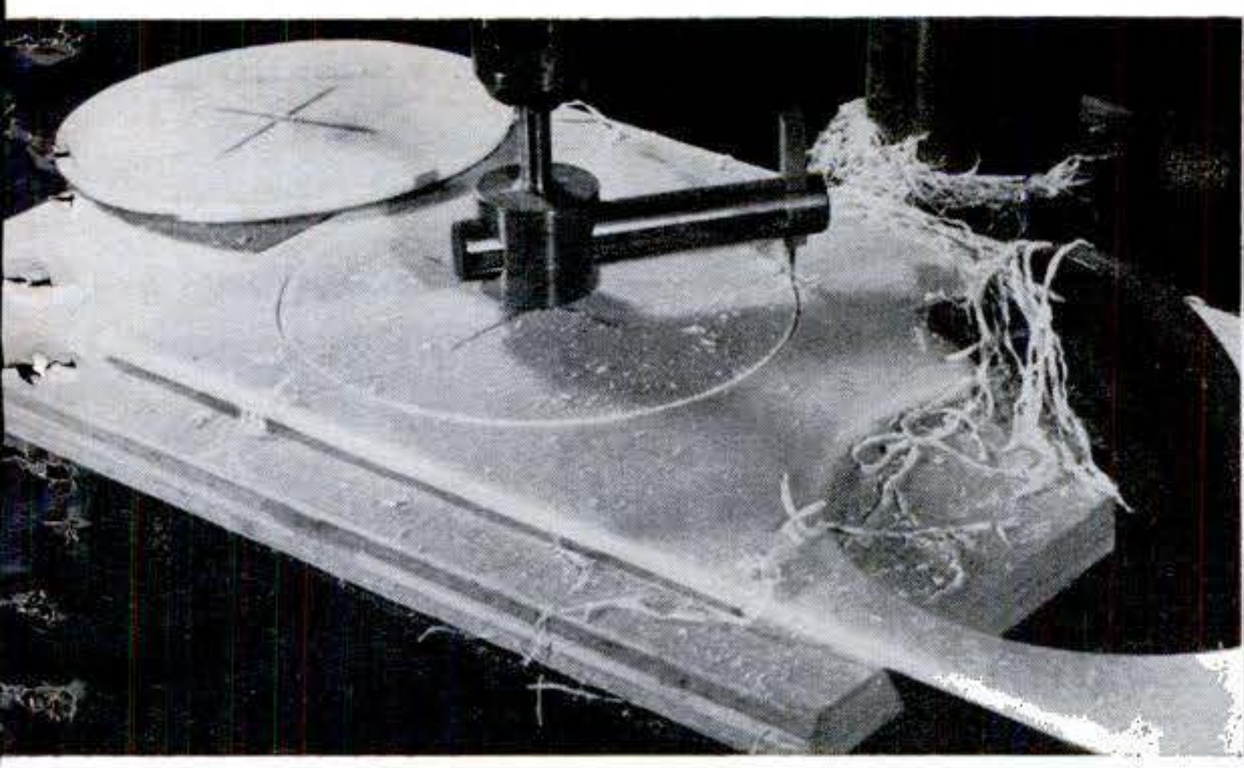
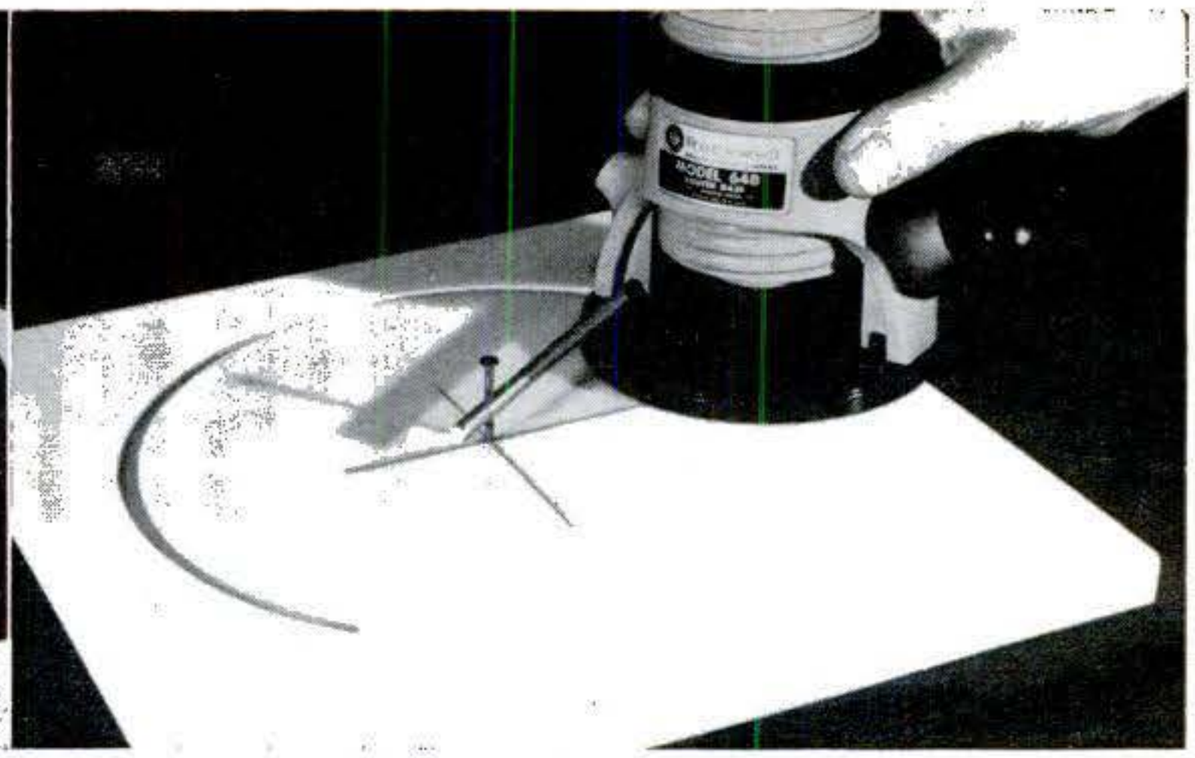
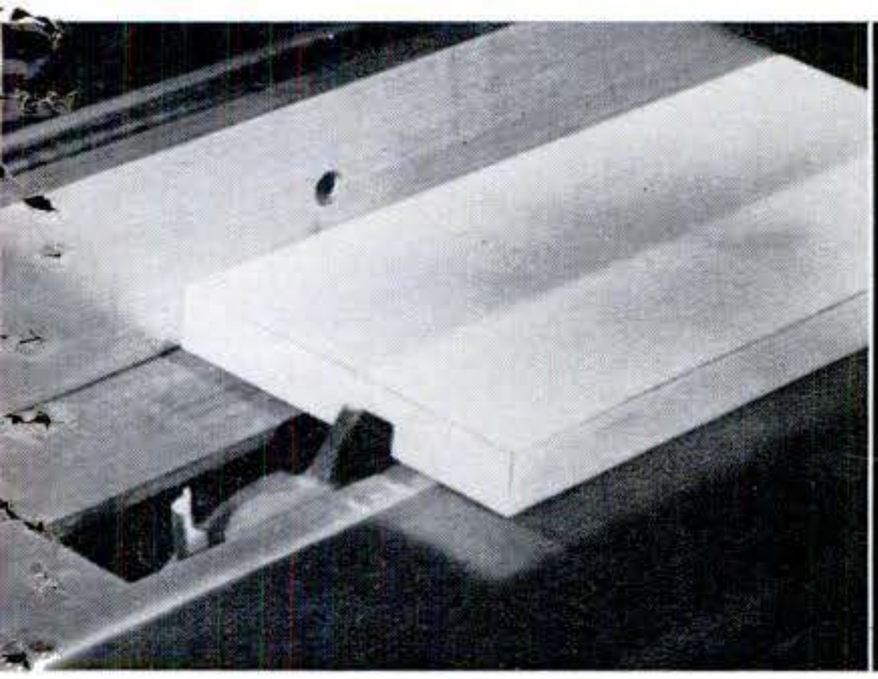
and Corian are all you need to become a first-rate "marblesmith"



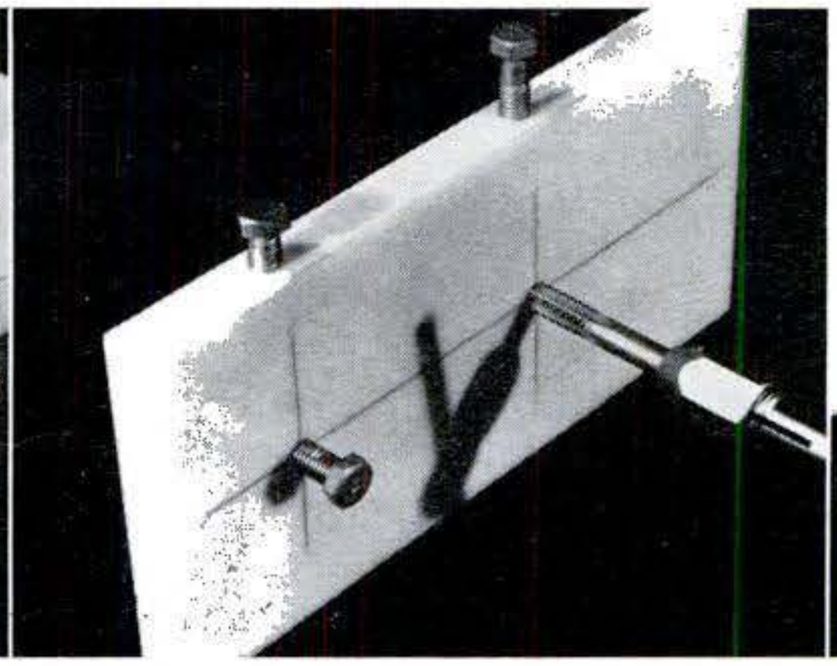
Fly cutters do a beautiful job on large holes, or for cutting out disks. Shredded-wheat appearance of shavings indicates good feed pressure. Use your lowest cutting speed for best work.



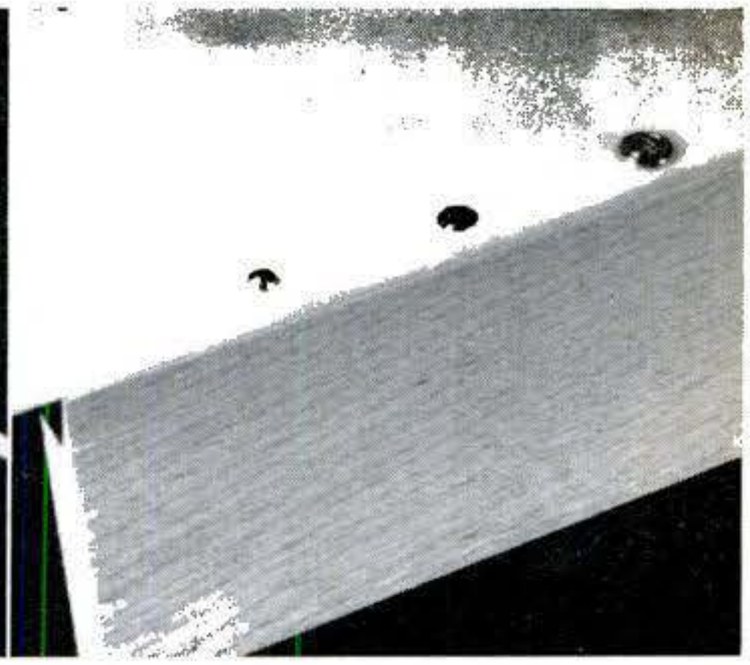
A router is the best tool for large internal cutouts. A sharp high-speed steel bit cuts quickly and leaves clean edges. Routing and turning make lots of chips—so wear safety goggles.



For dadoes and rabbets, accessory cutters work, but depth you can get in one pass varies with dado width. Repeat full-depth passes with O-gauge blade work, too.



Pilot holes for tapping should be slightly tighter than usual. Machine tapping benefits from a little lubrication; but for hand work, doing it dry will work out okay for you.



Regular screws work fine if you want to fasten Corian to a wood frame. Drill the Corian to full shank size, and stay at least 3/8" in from the edge to prevent breaks.

Hole forming. Good spade bits at woodworking speeds do a fine job. You might be inclined to let up on feed pressure—but don't. The result would be slow work and quick dulling. Under correct feed pressure, Corian will respond by spewing out waste like snowflakes.

Twist drills work, but retraction is required more frequently than with wood. Heat build-up in the hole can clog the flutes. Should this happen, let the tool cool. Then you can flick away waste with a fingernail.

Fly cutters of various design are good for holes larger than you can make with spade bits. With such tools, rpms are dictated more by the size of the tool than the operation. A fly cutter doing a 6" hole at excessive speed can walk a drill press across the floor. So start at your very-low-end speed and increase only if you discover that efficient feed pressure causes the tool to stall. The bit has to keep cutting; that's the gist.

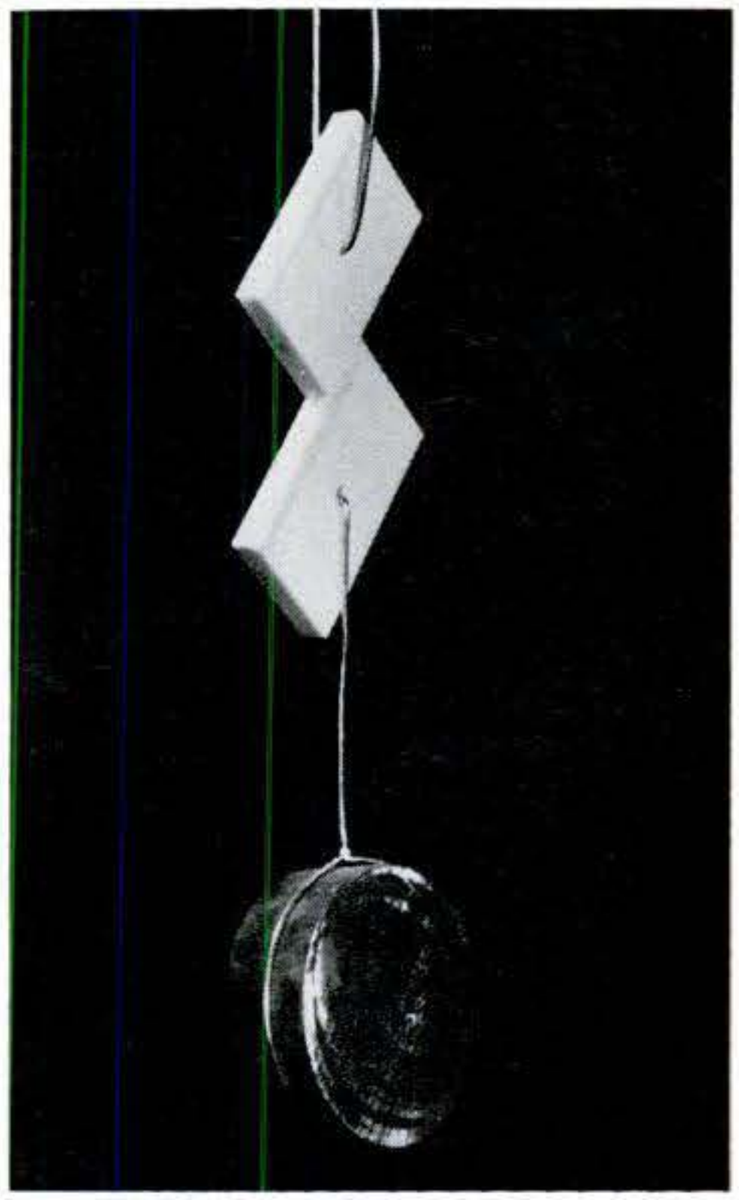
Most times, whether working with a portable drill or on a drill press, you'll function more efficiently when the work is clamped. For through holes, follow the usual backup-block precautions to minimize chipping on breakthrough.

Hole saws work okay; even plug cutters can be used. In general, Corian behaves on a drill press pretty much like a hard, grainless wood.

Routing and shaping. Test cuts under home-workshop conditions and objectives worked out so impressively there didn't seem much point in going into carbide tools. Conventional high-speed cutters used in 1/2-horse and larger portable routers, or on individual shaping machines, will work out fine if you apply procedures you would normally use when working with birch or maple.

Keep the work firm, feed slowly, make repeat passes to achieve deep cuts. To establish some sort of a norm, count on three passes to cut a 1/4" groove through 3/4" stock. With a big, fat router I did this easily in two passes but it's better to judge after an initial cut with your own equipment. The point is, the quality of the cut doesn't suffer with light equipment—it just takes more time.

[Continued on page 116]



Trial glue joint made with epoxy held together under the pull of heavy steel weight. Similar joints dropped from 25 feet onto concrete survived with no glue failures.

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How to Tote Your Motorbike

Racks, trailers, tie-downs make the carrying job easier—as this picture story shows

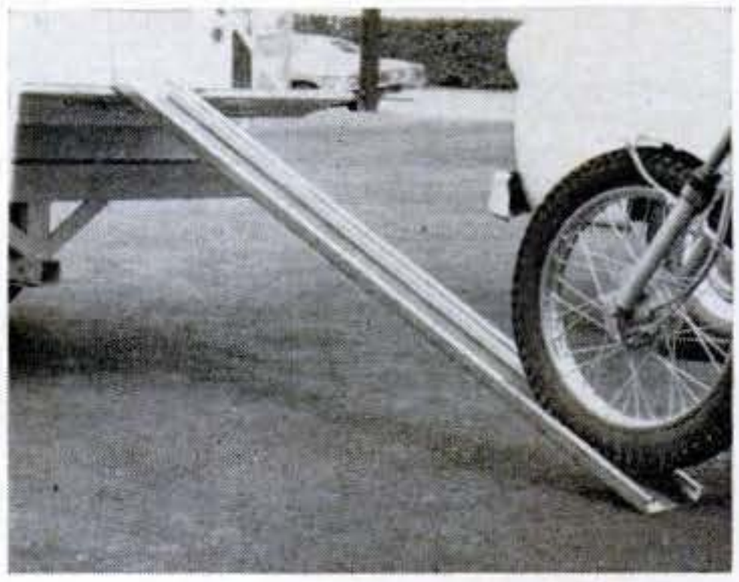
By JIM DAVIS

A universal bumper rack will carry most light- and middle-weight bikes. This one, from Webco Inc., 218 Main St., Venice, Calif., takes only a few minutes to install.

A towing rack handles a good-sized bike at about one-third the price of a trailer. Trail-A-Bike Inc., 221 South 19th Ave., Yakima, Wash., makes them in models to handle one or two bikes. Since the rear wheel of the bike turns with this kind of setup, on long trips it's a good idea to disconnect the motorcycle's drive chain.

Dismount the rear wheel (above) and many bikes will slip into the rear of a station wagon. Be sure to fasten the bike securely with tie-downs to prevent shifting around.

Make your own trailer (below) from an old car axle and wheels. A channel rack for the front wheel plus tie-downs front and rear will assure your bike arrives when you do.



Channel construction bolsters this light-weight aluminum loading ramp (above), automatically steers your bike up the non-skid surface and into your pickup.

Double racks can handle two bikes if you make sure the mounts attach directly to the vehicle's frame. You just can't expect a bumper to support the weight of two bikes.

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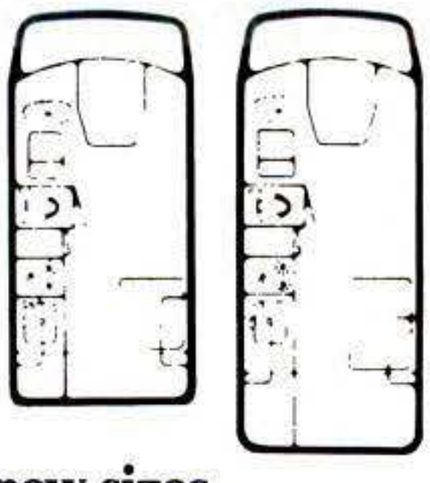
Chevy Van/Sportvan:

You can get in more of everything -including vacations.



Two new sizes, long and longer.

We've gone to greater lengths for camping enthusiasts. Both Chevy Van and Sportvan offer two wheelbases, up to 125 inches.

There's nothing like them for camper conversion—self-contained camping at least expense.

(Independent companies sometimes raise the roof before they add range and refrigerator, sink, dinette and sleeping for six.)

New sliding side door for easier ins and outs.

Our sliding side door runs smooth and quiet on triple tracks. One hand glides it. And you only need 4½ in. of clearance when you park.

New, weather-protected step, too.

More V8 power. Biggest standard six.

Van engines don't come any bigger than our 350-cubic-inch V8. And our standard 250 six can't be topped either.

So when you want to pack up and go, you pack up and—go.

Super Suspension for smoother, trucksaving trips.

A lot of Chevy's traditional longer life rests on suspensions that soak up the bumps and jolts that age other trucks.

Like our independent front suspension. And two-stage rear leaf springs that automatically adjust to changing loads.

Easier to service. 26 ways.

Looking after our '71 van goes quicker because you can make 26 service checks through its new front hood. Including things like carburetor and fan belt that are hard to get to on other makes.

Don't make a move this year until you hear all about Chevy's '71 vans. Your nearby Chevrolet dealer's the man to see.

Chevrolet

Totally tougher trucks.

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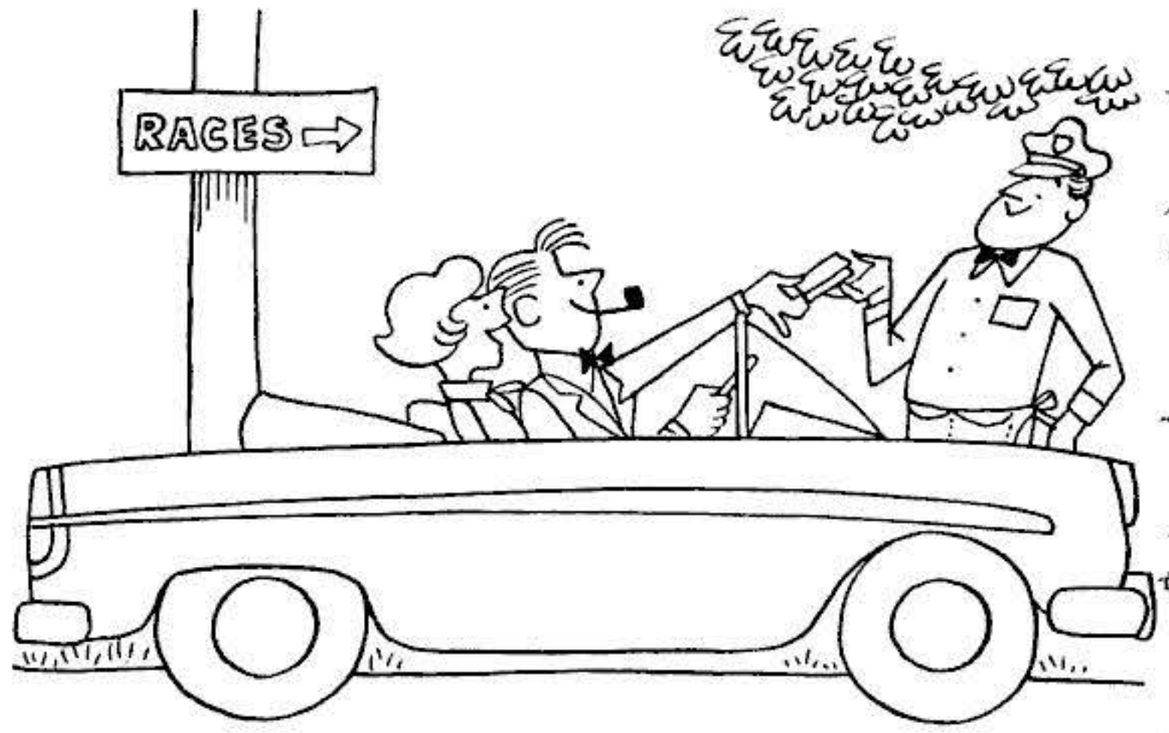
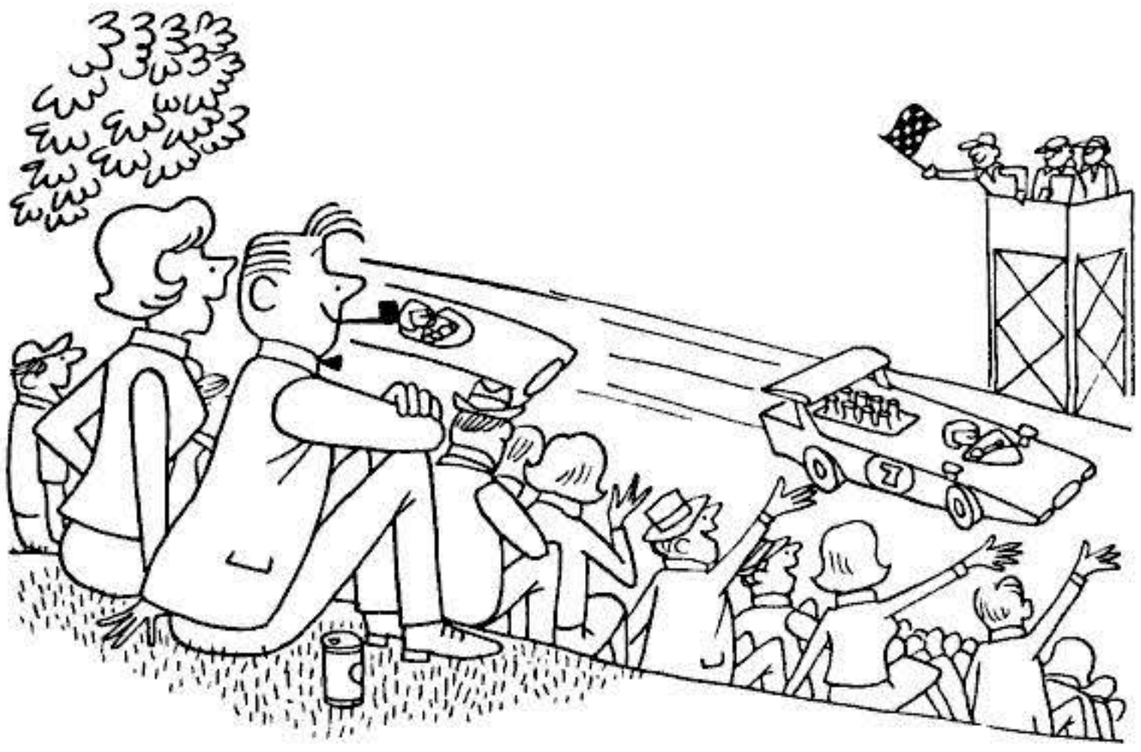
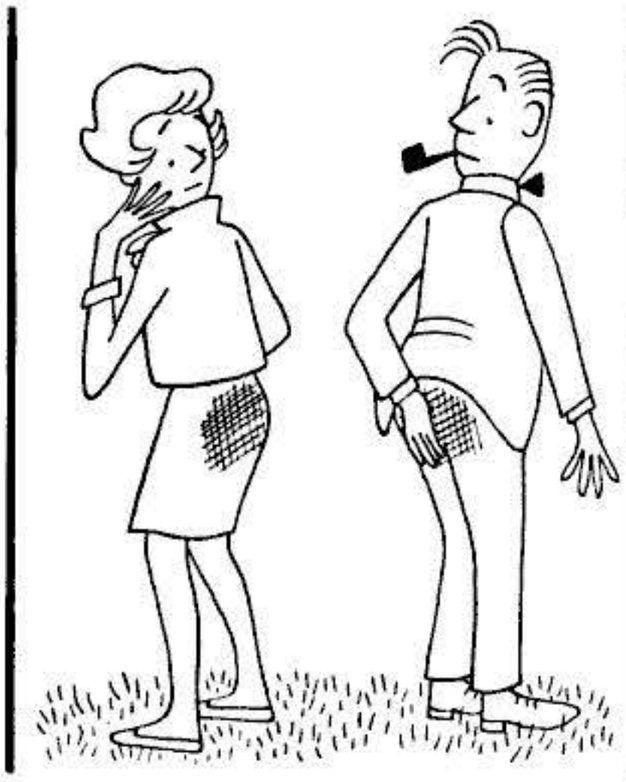
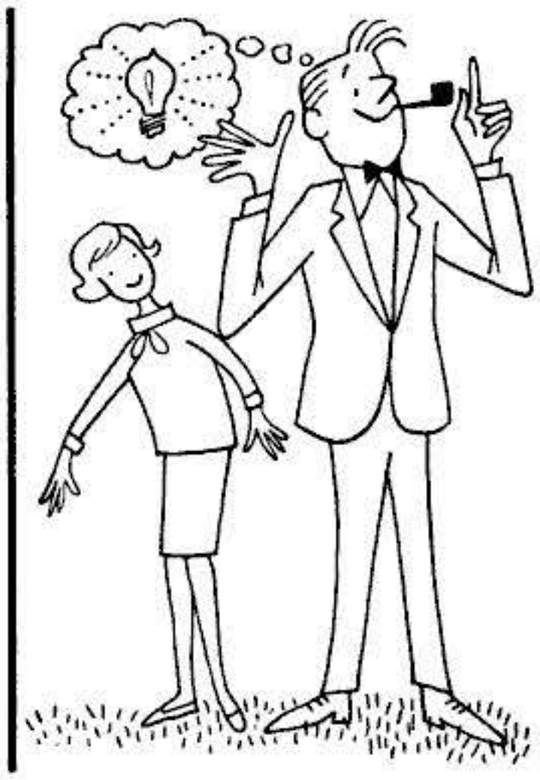
Wordless Workshop

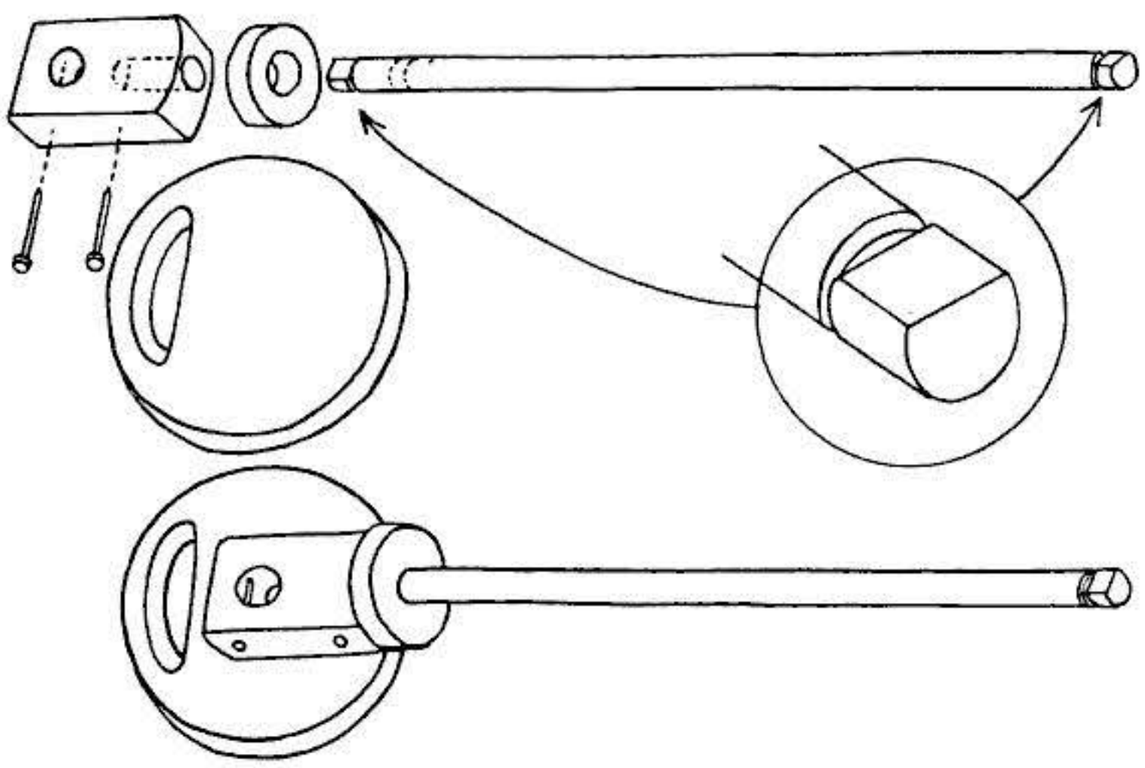
By ROY DOTY

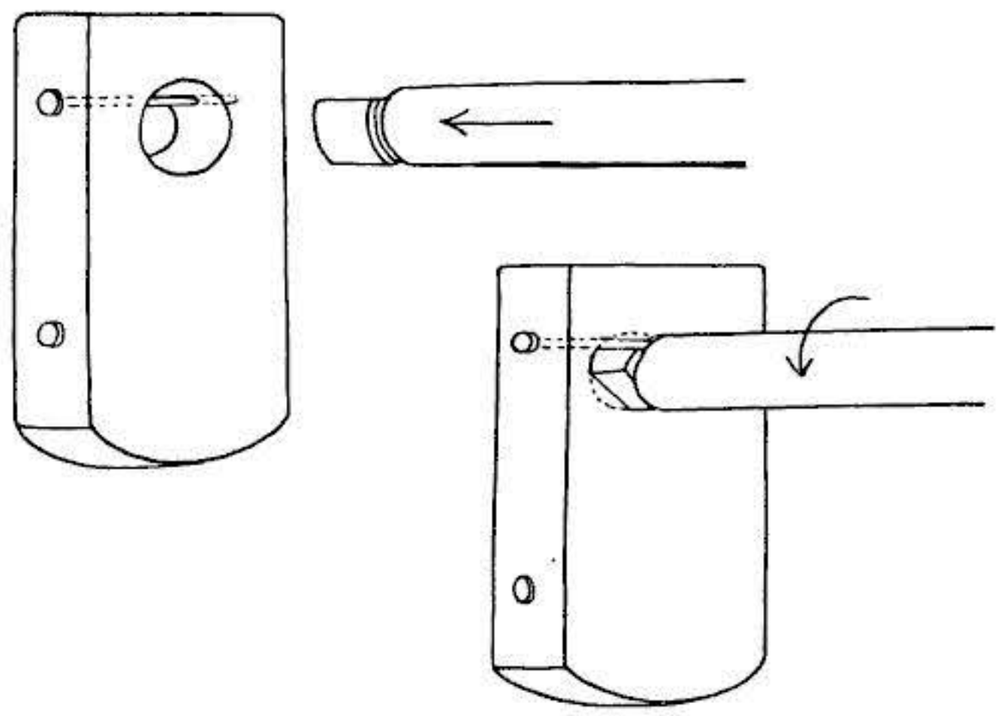












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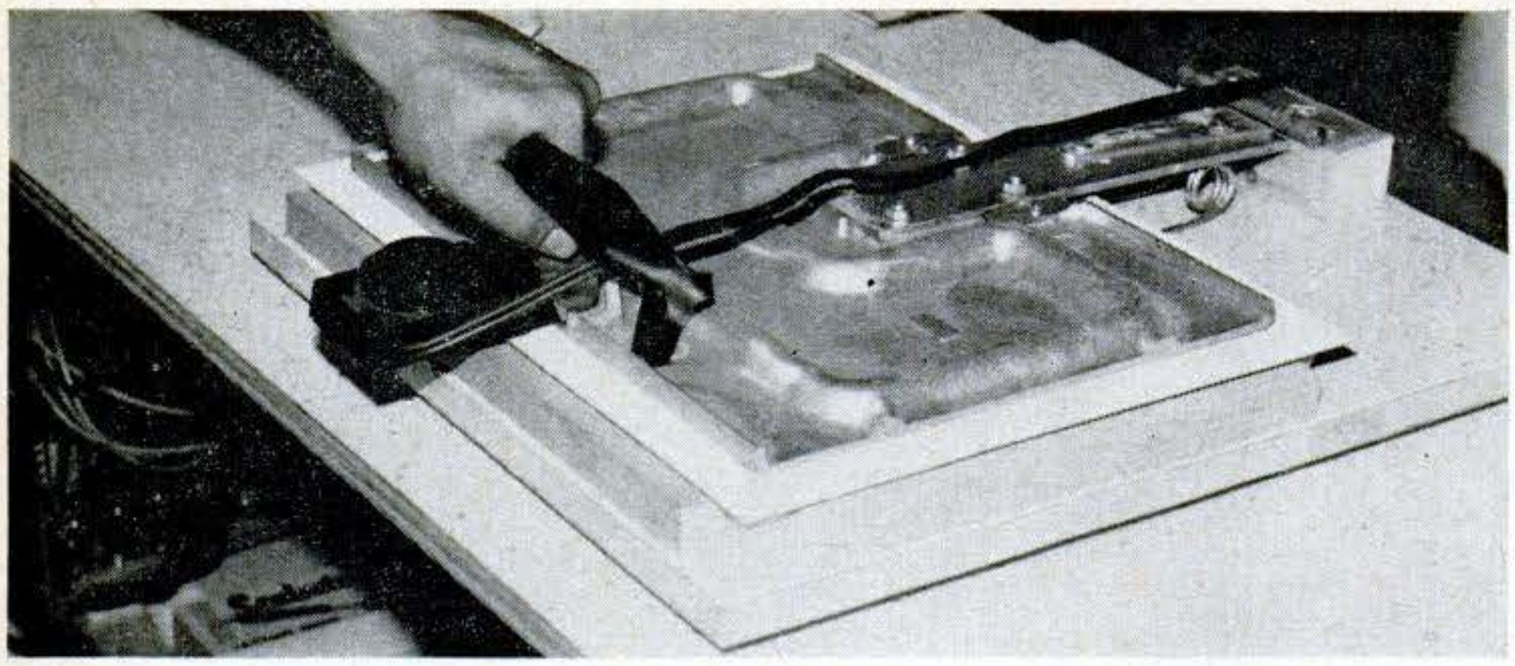
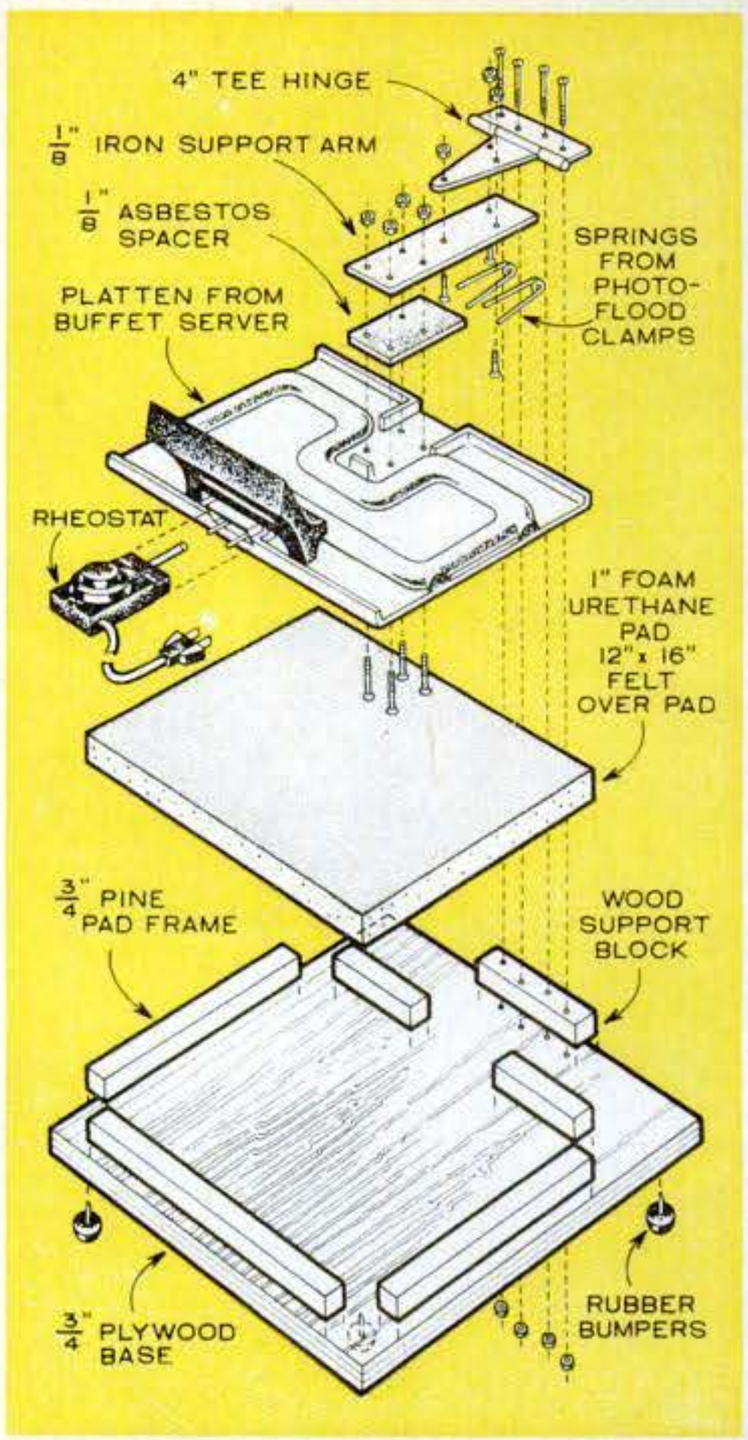
"I ask one thing from my cigarette: real tobacco flavor. You better believe I get it. I smoke Old Gold Filters."

Old Gold Filters. The cigarette for independent people.

Make a Dry-Mount Photo Press



Dry mounting is the neatest, quickest, most permanent way to mount photos for display.



Good photos should be seen, not stored. But unless you mount your pictures and display them, they'll end up hidden away in the backs of drawers. This heat press equips you to mount your photos at a budget price. It's made from a rheostat-controlled buffet server, available at Sears stores —but not in the catalog. It's model number 620 65740.

To turn the tray into a flat platen for mounting, you'll have to cut off the raised ends and grind down the beveled sides. A machine shop can do this for a few dollars.

Three quick hints: Shim with cardboard under the foam pad to achieve even contact between platen and print. In use the server is upside down, so remove the rheostat and turn it over in its socket. Solder or braze the photoflood-clamp springs to the bottom of the support arm.

A setting of 250 works fine for black-and-white prints. A minute or two in the press with moderate pressure should bond a print in place. Check by flexing the mount. If the print bubbles or pops, press for another minute.—*J. Ronald Eyton*

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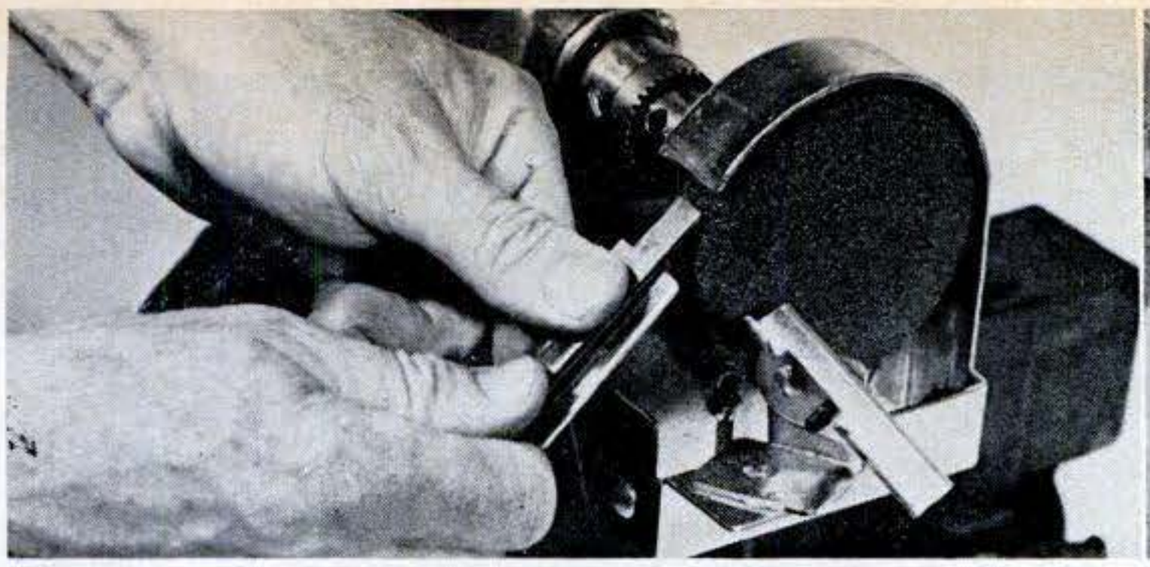
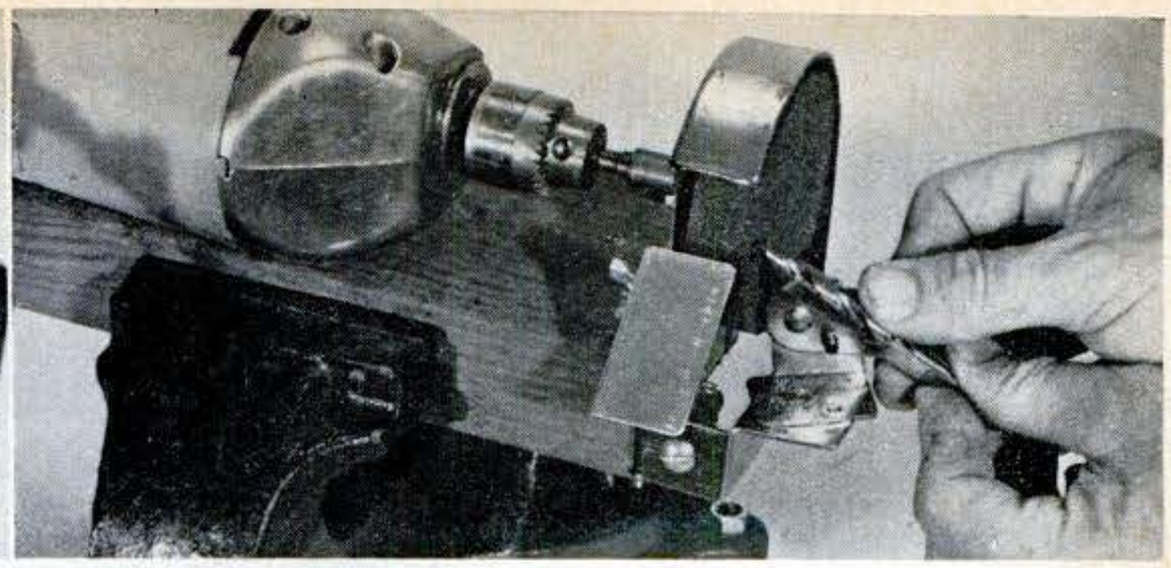


Simple electric-drill adapter sharpens light cutting equipment with ease. Safety-rated stone is well chosen for 2,000-rpm range.



Adjustable drill guide determines lip angle and clearance during grinding. Tool's performance is more impressive than appearance.

PERSONAL-USE REPORT

Turn Your Electric Drill into a Sharpener

Now you can sharpen drills and edge tools without investing the space and equipment needed for a permanent grinder setup. Zim's new grinder attachment is powered by any quarter-inch electric drill. And the V-shape drillrest even assures correct angle on both cutting lips of the drill, which is often a problem for the most experienced craftsman.

The tool doesn't inspire confidence on first sight. It's made of stamped sheet metal, and it makes no provision for securing the drill body.

However, the grinder proved itself in actual performance. You screw the unit to the end of a short piece of two-by-four and clamp it in a vise or on a bench top. The electric drill rests quietly in place, and a degree of free-swiveling action in the grinding-wheel-shaft bearing permits automatic alignment without binding.

For drill sharpening, you first adjust the drill to the desired angle. During grinding, the drill and guide swing through a travel pattern established by a pivot and curved slot in the drill-guide base. The resulting combination of angles produces the accurate lip profile and clearance so difficult to generate by hand.

For regular edge-tool sharpening, the tool rest is canted to the proper angle and locked. My tests showed that sharpening is satisfactory for plane irons, hand chisels, knives—any small tools within the power capacity of a quarter-inch drill. Heavier cutting tools require heavier equipment.

Price is a definite plus for the No. 2600 Drill and Tool Grinder: just $4.95, from Zim Mfg., 2850 W. Fulton St., Chicago 60612.—*E. F. Lindsley*

...for less than you'd expect

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ROTARY ELECTRIC MOWERS

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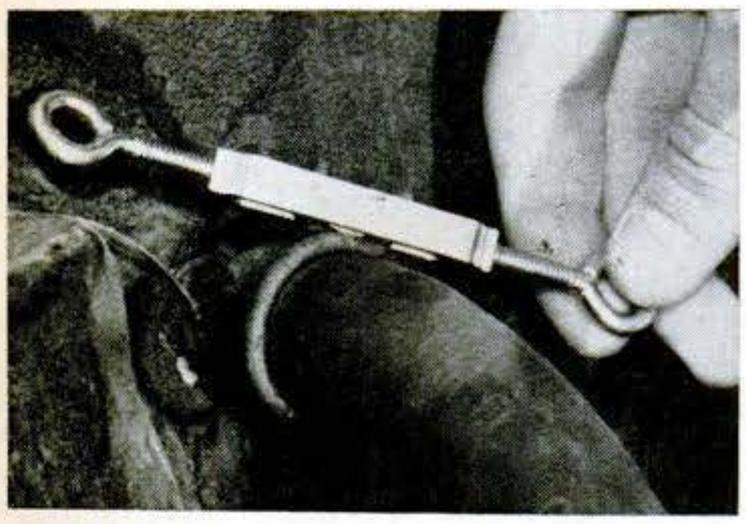
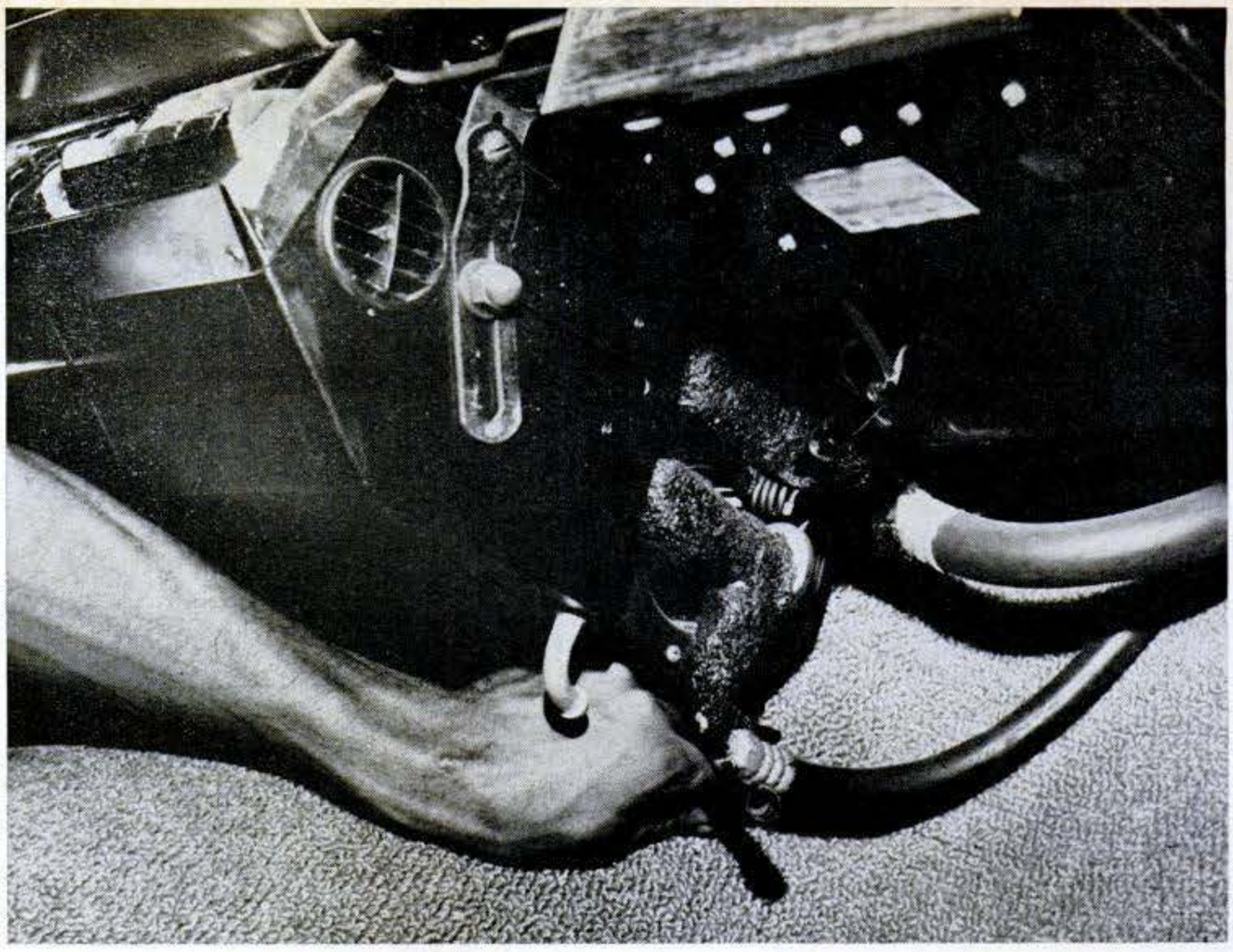
Taking Care of Your Car

Good hints others have used

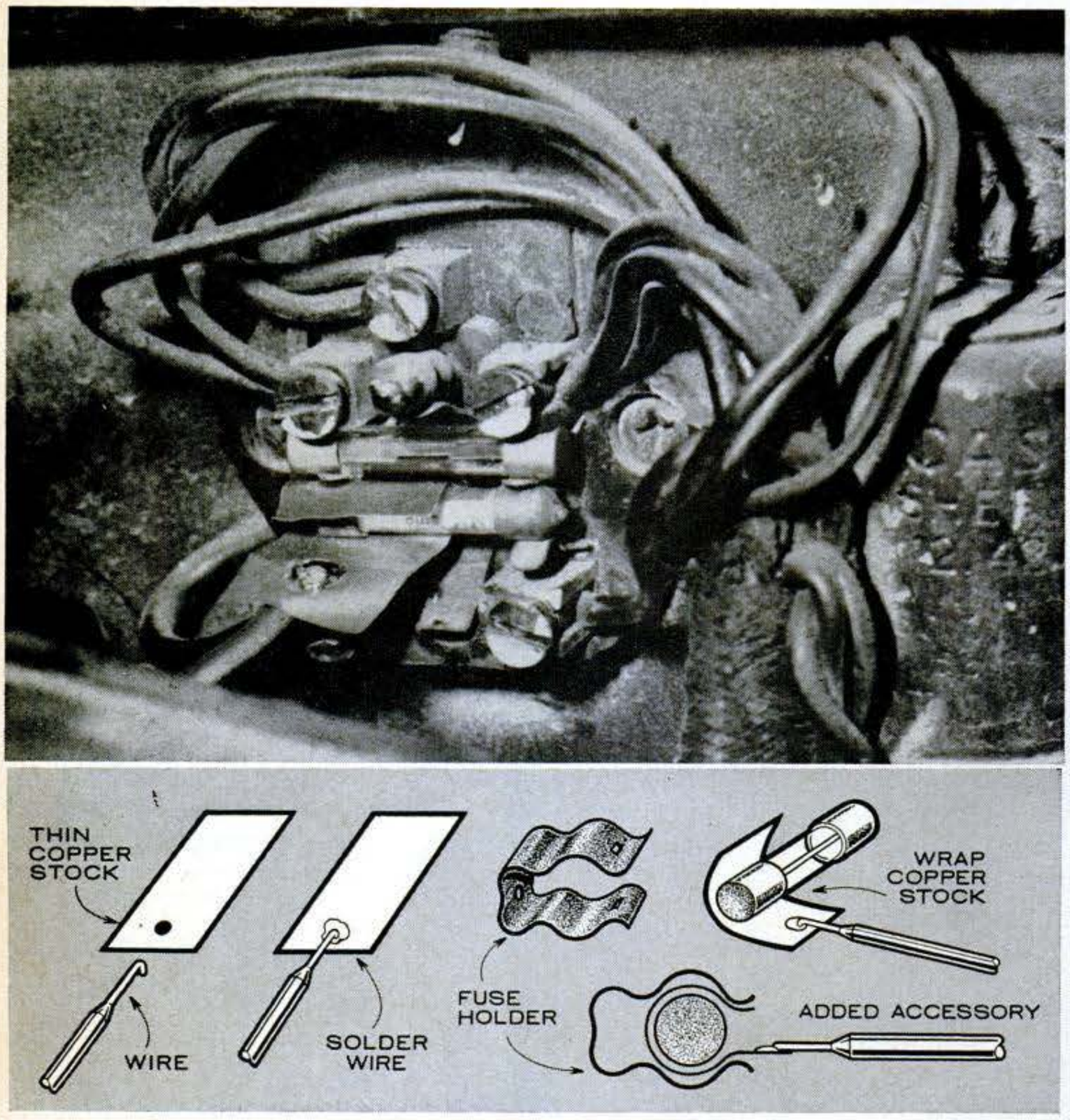
Got a car tip? We pay $25 for each one accepted. Send it to Car Care, Popular Science, 355 Lexington Ave., New York, N.Y. 10017. None are returnable.



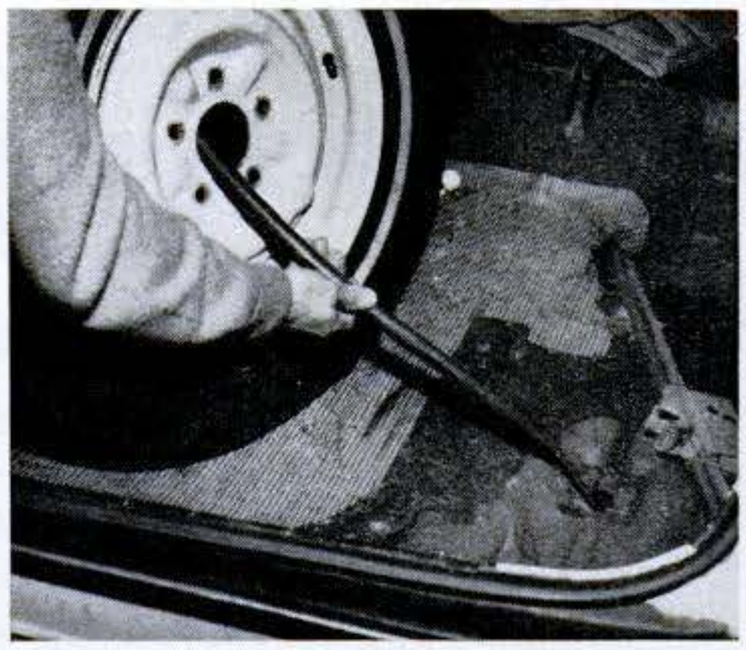
A three-inch turnbuckle simplifies the job of removing and replacing spring-type hose clamps. Just slip the clamp ears between the shafts of the eyebolts as shown above. Then twist the bolts to open the clamp.



If you wind up with a puddle of water on the floorboards when you turn on your car's a/c this spring, the tube that drains condensed water is probably plugged with winter road dirt. An a/c shop may charge you a bundle to fix the problem, but you can handle it yourself in a few minutes. Just find the tube and squeeze it to break the dirt plug loose. On most cars, the tube is on the underside of the unit on the firewall.



Plug-in connections and fuse blocks have just about eliminated terminal screws and nuts. Where to hook into the wiring when adding electrical accessories? At the fuse block. Just solder a wire to a thin sheet of copper or brass—shim stock works perfectly—wrap the sheet around a fuse, and slip the fuse back into the fuse block. Connect the other lead to a clean ground, and you've got juice for one more accessory.



Why struggle getting the hold-down bolt through your spare tire when replacing it in your trunk? Slip a few feet of old hose through the wheel, and over the bolt as shown, then set the tire in place.

Toothpaste can remove scratches and haze from convertible windows. Dip a damp rag in the paste, and rub it over the affected areas. The fine abrasives clear the plastic in minutes. Finish with a dry rag.

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A plug for people who change their own

We figure you power buffs have lots of interests and lots of equipment to go with them. So NGK builds a plug for practically every internal combustion engine made.

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NGK, the long life, hi-performance plug.

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How to Work with Corian

[Continued from page 107]

Even with a small router you should be able to go about 1/4" if you don't rush the feed.

Be sure that bearing collars on a shaper are clean and smooth and that work edges (whether you intend to mold with a portable tool or a shaper) are sanded smooth. As usual, any irregularities there will be duplicated by the cutter.

Large, internal cutouts of any shape are best done with a router. Circular ones are done beautifully when you pivot-guide the tool. For other shapes, make yourself a hardboard pattern and use a template guide in the router base. Be sure the router base is clean and waxed before you work. On *internal* cutouts, pivot-routing, and the like, move the tool in a *clockwise* direction. On edges, work the other way.

What adhesives? For woodworking-type joints, wood glues are out, epoxies are in—specifically, Devcon's EK-20 in clear or white. I dropped Corian-to-Corian joints about 25 feet onto concrete without failure and this has to prove something. As usual with this type of adhesive, how you mix and apply is crucial. Follow package directions carefully.

For laminating—Corian-to-plywood, for example—conventional contact cements work fine. This does impose the instant-bond restriction that demands precise placement of mating pieces. A less demanding way to go is provided by mastic-type materials such as Panel Grip (Columbia Adhesive) or Royalcote adhesive (Masonite). They're available from building-supply dealers or lumber yards.

Poly-Seam Seal is another brand name to look for. This is more a caulking material but it has adhesive properties that work well with Corian.

Mechanical fasteners. I've nailed this stuff after drilling pilot holes that were smaller than the nail-shank diameter by 10 to 15 percent. This was to satisfy my will-it-work curiosity. Nails and Corian are like liverwurst and caviar.

The material can be tapped for bolts or machine screws, drilled for sheet-metal screws, bored for "mollies," and so on. Wood screws will grip, but you'll have to work with them as you would with sheet-metal screws or self-tapping screws.

If there is a generalization concerning tapping and drilling for screws, it's to hedge a bit on the tight side when drilling the starting hole.

No special procedures are called for when counter-sinking or counter-boring. Do, when using screws on edges, maintain at least a 3/8" edge distance—especially on 1/4" stock.

Sanding and finishing. Commercial houses may want to equip themselves with silicon-carbide abrasives, but the kind of things you and I are likely to do can be handled with our prosaic garnets or aluminum oxides.

Whether you work by hand or with power tools, consider #80 to 120 as the stuff to use for rough work. Use #120 to 240 for general touchup work, rounding corners and the like, and anything from #240 to 600 for the final cheek-smooth finish.

Belt sanders may be used, but you'll be better off if you work carefully in the first place. Then belt-sanding will never be necessary. Pad-sanding is another story—if you can accomplish cuts that require no more than a pad-sanding with 120 or finer paper, you're in good shape.

Corian has a built-in finish. Any cut you make can be polished to surface-gloss quality. On my lathe test, I accomplished this after sanding merely by burnishing with fine steel wool. Surfaces and edges can be finished by buffing with soft wheels and a slightly abrasive compound—the kind of stuff you use on your automobile. Rottenstone, pumice, Bon-Ami are all applicable.

When power-tooling, keep speed and pressure against the Corian to a minimum that is consistent with good work. Avoid excessive heat-building friction. It won't speed up anything and can result in buffing marks that require more work to remove.

One peculiarity of manufacture is that the vein color (you've a choice of beige, gray, or olive) tends to sink toward the back face, leaving a pattern on the "good" side that's too subtle to show in most of our photos. If you want a more pronounced pattern, you might decide the unfinished back of your panel is worth smoothing for use, instead.

How about cost? Corian should run around $4 a square foot for the 1/4" stock, and $8 for 3/4" thickness. Those of you in the East can get exact prices at your building-supply dealer. West of the Mississippi, you'll have to wait until Corian reaches you later this year to get actual prices.

Incidentally, if your mind is racing ahead toward the possibility of heat-forming sheets, or toying with the use of solvents to make fillers from dust and shavings—sorry. My efforts failed, and DuPont says it won't work—not under home-shop conditions, anyway. Wish I could have sent them a Corian bowl. PS

Action at Your Fingertips

[Continued from page 97]

pliance on or to turn it off for a certain duration of time.

Building it. Solder the components as shown. The terminals of the relay must be bent slightly to fit the provided holes, and the unused terminal of R9 has been cut off. The SCR we used was selected for its low cost. It's made by Carl Cordover and is available at William Electronics Supply, 1863 Woodridge Ave., Edison, N.J. (two for $1 plus postage).

Use sleeving over the bus wire going to the battery terminals; wrap the input wire under a plate-mounting screw for the input connection.

Cut or file one end of the board, as shown. It will neatly fit into a 1½"x2½"x5" minibox. Use 6-32 nuts and screws with large-pattern nuts as standoffs. When the board is dropped into place, the two nuts behind the batteries will touch the plus and minus trace of the printed-circuit pattern, allowing you to charge or substitute the batteries from the rear.

The smaller the plate, the more sensitivity you can achieve. Too large a plate and the Touch Switch will simply keep sequencing from added capacity. Experiment with the values and wiring of R1 and R2 to get best sensitivity for your plate.

The dotted section of the schematic outlines different configurations of R1 and R2 which you can try. Extra holes in the printed-circuit board will let you install the resistors in the way you've selected. There is also an extra shield hole for a shielded cable input if you want one, but keep it minimum length.

Values given for R1 and R2 are nominal, so you can experiment with those also; but for our purposes a 10-megohm resistor in series with the plate (as in layout) worked very well. (Dotted section A, R2 is omitted.)

Once it's between gun-shy and trigger-happy, mount the board in its container. Wire the phone plug for either normally open or normally closed operation, plug it in, and the Touch Switch—if you'll pardon the expression—is right at your fingertips. PS

PARTS LIST

R1—10-megohm, ½w carbon resistor, (see text)
R2—1.5-megohm, ½w carbon resistor (see text)
R3—47-ohm, ½w carbon resistor
R4—33,000-ohm, ½w carbon resistor
R5—10,000-ohm, ½w carbon resistor
R6—18,000-ohm, ½w carbon resistor
R7—1,000-ohm, ½w carbon resistor
R8—15,000 ohm, ½w carbon resistor
R9—1-megohm, ½w carbon potentiometer
C—50mfd, 25v electrolytic capacitor (see text)
Q1—N-channel FET (Int'l Rect. FE 100-C)
Q2—transistor G-E 2N657 or equiv.
Q3—2N1671-B Unijunction transistor
Q4—2N3638 transistor
SCR—Motorola HEP 320 or see text
K—SPDT, 12vDC relay (Calectro D1-963)
B1, B2—15v battery (Burgess K19)
Misc.—Stereo phone plug and jack, minibox, printed circuit kit (see text)

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SHOP TALK

By ROBERT P. STEVENSON

Two reports of possible interest to car buffs

For years, Dupli-Color Products Co. has specialized in factory-matched touch-up paints for cars. The company now offers an informative folder—"How to Spray-Away Scars on Cars." It's free. You also get a colorful decal for the car. Send a self-addressed stamped envelope to Harvey Brown, Director of Racing, Dupli-Color, 1601 Nicholas Blvd., Elk Grove Village, Ill. 60007. Ask for the do-it-yourself booklet . . . Think you could design a better-looking car than any of Detroit's products? Well, maybe you could. You can find out what's involved in getting into this profession by requesting an illustrated brochure from the Engleton School, Box 207, Woodland Hills, Calif. 91364.

Notes from here and there about tools

In these days of fine power tools, you might conclude that nonpowered hand tools eventually may be outmoded. But this apparently is unlikely to happen. Information from Pendleton Tool Industries indicates that the market is expanding everywhere for hammers, screwdrivers, handsaws, wrenches, and the like. Computer studies made by the company forecast a startling growth in demand for such tools in the international market. In fact, the demand may double by 1975 . . . Be careful when you use a portable circular saw. E. L. Tabat, vice-president and manager of Rockwell's Power Tool Division, declares that this useful tool, in the hands of "careless or inexperienced users," accounts for the overwhelming majority of accidents involving consumer power tools . . . Shades of your razor-blade dispenser! Stanley now sells replacement blades for utility knives in a dispenser you hang on your tool board (see photo). It holds 100 blades . . . Quality paintbrushes with bristles of DuPont's Orel, a tapered polyester filament, are available from several brush manufacturers. As explained here in September, 1969, these filaments have superior qualities for application of both oil-based and water-based paints. Brushes with Orel can be identified by the word "ester" on the handle . . . Rohm and Haas has introduced special high-speed twist drills for making holes in its Plexiglas. You'll find the new bits at building-supply houses that handle the acrylic sheet . . . Wen's introduction of a line of double-insulated portable power tools is another good step toward making all new portable tools electrically safe—as they've been in Europe for some time.

Like to visit an English craftsman's home?

Readers who expect to visit England ought to make a note of this name and address: Peter Child, The Old Hyde, Little Yeldham, Halstead, Essex, England. Pete Child identifies himself as a "woodturner craftsman." In an informal letter, he explains that he makes a business of teaching woodturning.

"The general idea is that you come along as my guest and stay with the family for a couple of days," he writes, "and I can teach you the principles of turning woods with the right tools handled the right way . . . My home is an old oak-beamed farmhouse in the Essex countryside . . . and you can be assured of a most comfortable 'working' holiday in a friendly family atmosphere. There are a couple of delightful country pubs of character close by if you feel in need of a reviver after a hard day's work!"

Now, doesn't that sound great? And that's not all of Pete's good tricks. Because standard lathe chisels did not satisfy him, he designed his own (see photo) and now offers them for sale. Even if you're not planning a trip across the Atlantic you might like to write to him for the details about these tools.

New Rotary Heat Exchanger

[Continued from page 48]

suggests forgetting about the water jacket and using the lubricating oil as the main engine coolant. This would, of course, take major redesign and huge tooling changes. It is true, however, that a large part of the heat rejection in modern heavy-duty engines is handled by oil heat exchangers of the shell-and-tube variety.

Cooling the home. Most research has gone into home-size air conditioners. The goal is smaller, cheaper, and quieter units. A test model built under the guidance of Dr. Wolfgang Leidenfrost and Prof. W. E. Fontaine of the Purdue Dept. of Mechanical Engineering has been operating for over a year. As with most such hand-built, breadboarded lab models, a bit of imagination is needed to translate it into a stylized box to fit your window or wall installation.

The unit runs very quietly. All you notice is the compressor hum. The lab model has no sound insulation, but properly housed this would be an air conditioner you could sleep with. About 1,800 rpm is peak for air-conditioner fans where low noise is vital. Radiators or condensers for cars can easily run at 2,200 to 4,000 rpm without getting into any mechanical problem.

In addition to low noise, freedom from evaporator icing is another advantage with the rotary heat exchanger. This is especially critical with automobile air conditioning in extremely hot and humid climates. The whirling blades tend to throw off moisture droplets before they freeze.

The air-cooling cycle (see photo) can be reversed for heat-pump heating, but it's easier to reverse the exchanger-blower discharge paths and let the heat from the condenser come back into the room. Either using dampers or rotating the housing or simply sliding the whole outfit on its mounts to realign the ducts would do the trick.

You may be seeing window air conditioners that incorporate the rotary heat exchanger on the market as early as this year. A Japanese air-conditioning manufacturer, Daikin Kogyo Co., has signed an agreement with Donbar, and could be shipping up to 50,000 units using the exchanger to the U. S. in 1971.

So far, the Donbar Development Corp. has touched three bases with their rotary heat exchanger: home and car air conditioning, Rankine-cycle condensers, and automotive radiators. Once you get started, it's easy for the mind to ramble on to larger possibilities—cooling nuclear power plants, for example. PS

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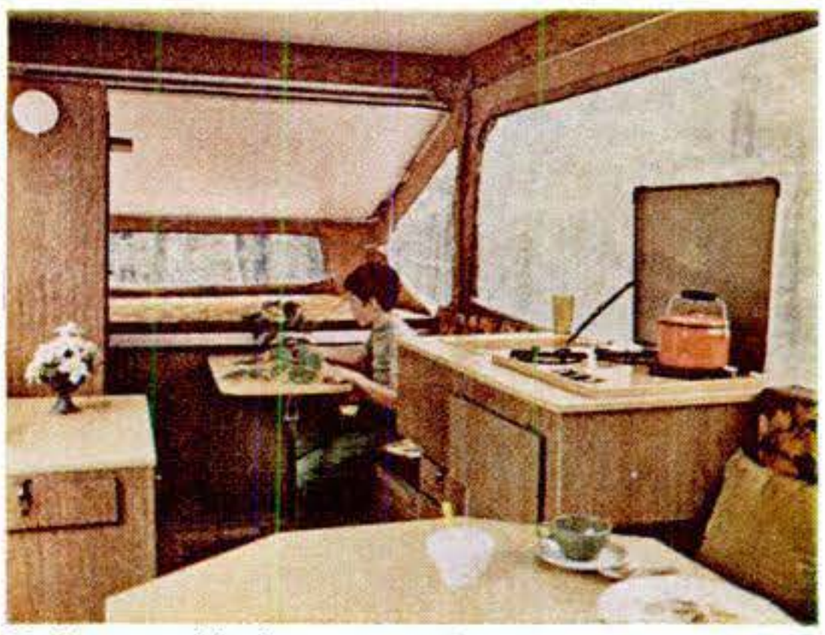

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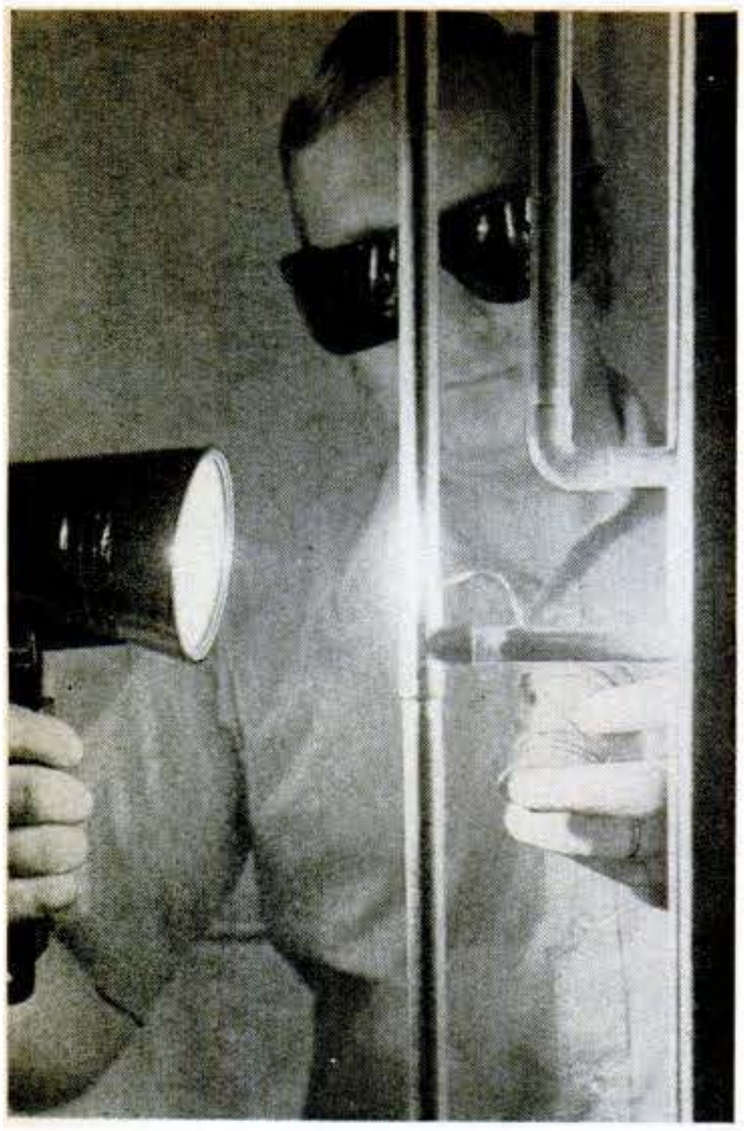


Lamp puts out clean flameless heat—enough to sweat-solder plumbing. Dark glasses supplied with lamp must be worn at all times.

NEW IDEA:
A Heat Lamp for the Shop

By PHIL McCAFFERTY

When is a movie light not a movie light?

When it has a hot new quartz-bromide bulb and is set up as the Torchlamp, doing handy things like de-icing a windshield, heating old paint or varnish for stripping with speed you wouldn't believe, drying film in your darkroom, or maybe starting a charcoal fire in your barbecue.

The makers have taken the high-intensity movie light and fashioned it into a multipurpose flameless torch. But just because it's flameless doesn't mean it won't burn things, for it does get *hot*. More about that later.

What else can it do? As it's a first cousin of the movie light, you could rig the handle with a bracket and mount it to a camera. The light is 3,400 degrees K color temperature and bright enough to shoot ASA 40 speed film at 10 feet using about an f/4.5 aperture setting.

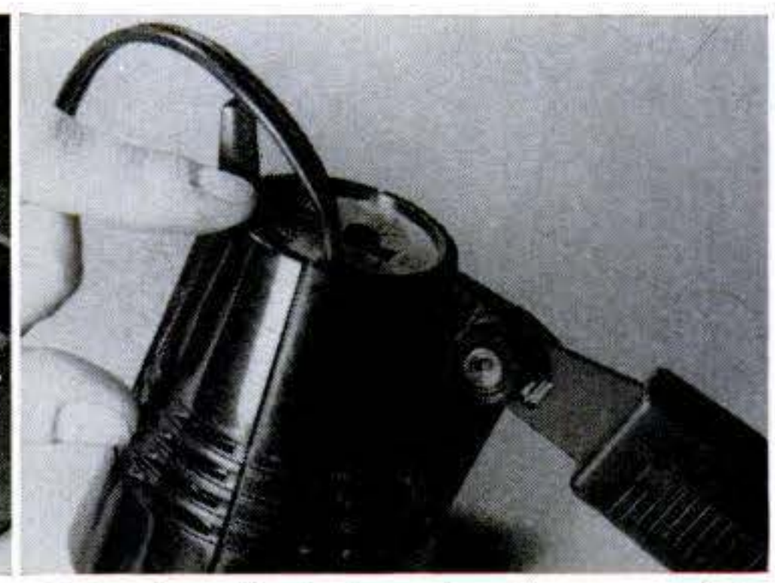
I quickly put mine to work tempering some small springs, and proceeded from that to a job of grain-raising on some wood. The lamp worked like a charm softening the putty on a window sash that needed reglazing—likewise speeding up the drying of some small parts I'd painted.

Some other things the handy lamp will do: warm cold engines and radi-

Continued

Removing paint is fast and easy. Hold the lamp about 10 inches from your work surface. Paint blisters and you scrape it away.

Lamp comes with dark glasses and a hook for hanging, is priced at $25. The stamped metal case is an option, raises price to $30.



Swiveling plastic lamp head stays cool in area between fingers, but front edge can burn you. Plastic handle stays very cool.

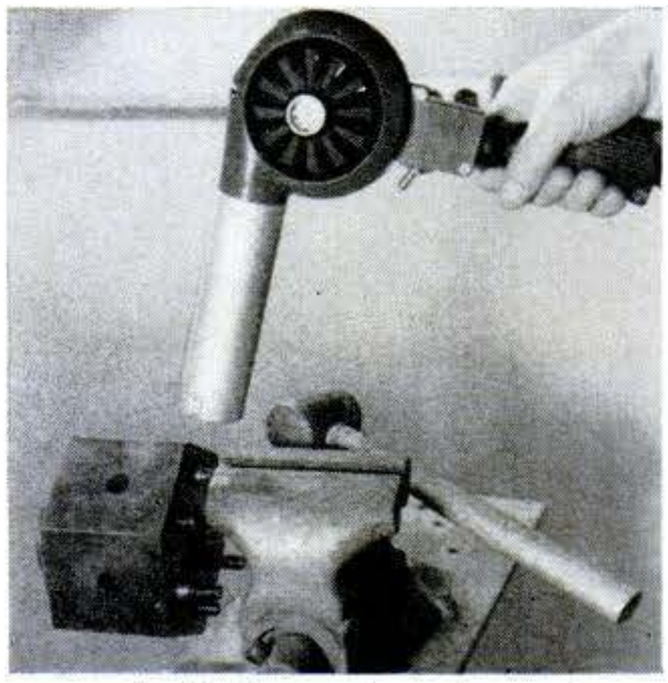
The heat gun: another source of flameless heat

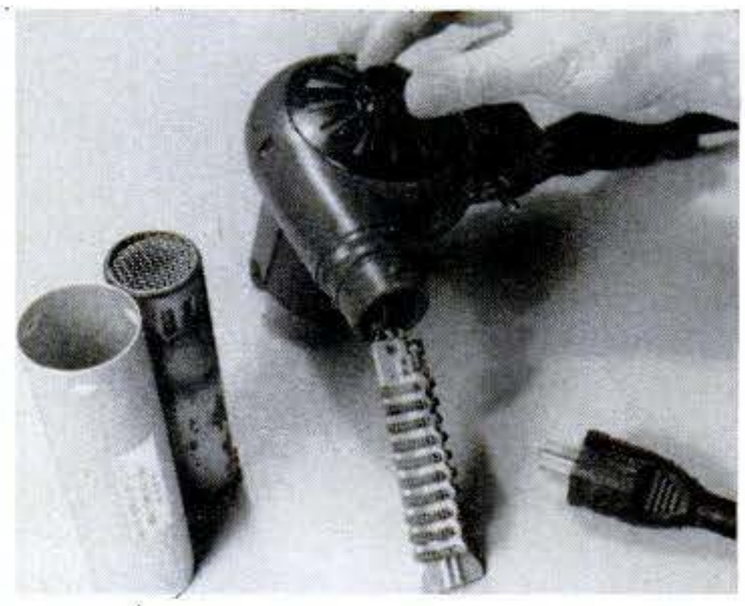
If you want flameless heat without a flood of bright light, you can get it at about twice the price of a heat lamp —in the form of a heat gun.

Like a super-duty hair dryer, the heat gun uses a resistance element to warm air, and a fan to direct it where you want it. The unit shown here—by Seelye Plastics, Inc., 9800 James Circle South, Minneapolis 55431—delivers 23 cu. ft. of hot air a minute. After a job, you flick the three-position switch. The heat stops, but the fan keeps blowing; gun and workpiece cool rapidly.

I used the heat gun to perform many of the same jobs I did with the lamp. I found it ran cooler, due partly to the fan and partly to the non-conductive Lexan housing. The tough plastic makes the housing just about unbreakable, and insulates against shock hazards, too.

Seelye's heat guns come in four 115-volt models with temperature ranges starting at 200-300 degrees F, going up to 750-1,000 degrees F. Prices are from $48.95 to $59.95. A similar line of electric heat guns is made by Eddy Products Corp., Elm Grove, Wis.—*Phil McCafferty*





Two-and-a-half-pound gun heats almost instantly, blows 750- to 1,000-degree air for jobs like freeing frozen metal parts. Business end of gun (disassembled, right) is heating element suspended in double-jacketed nozzle. Cord is heavy three-wire.

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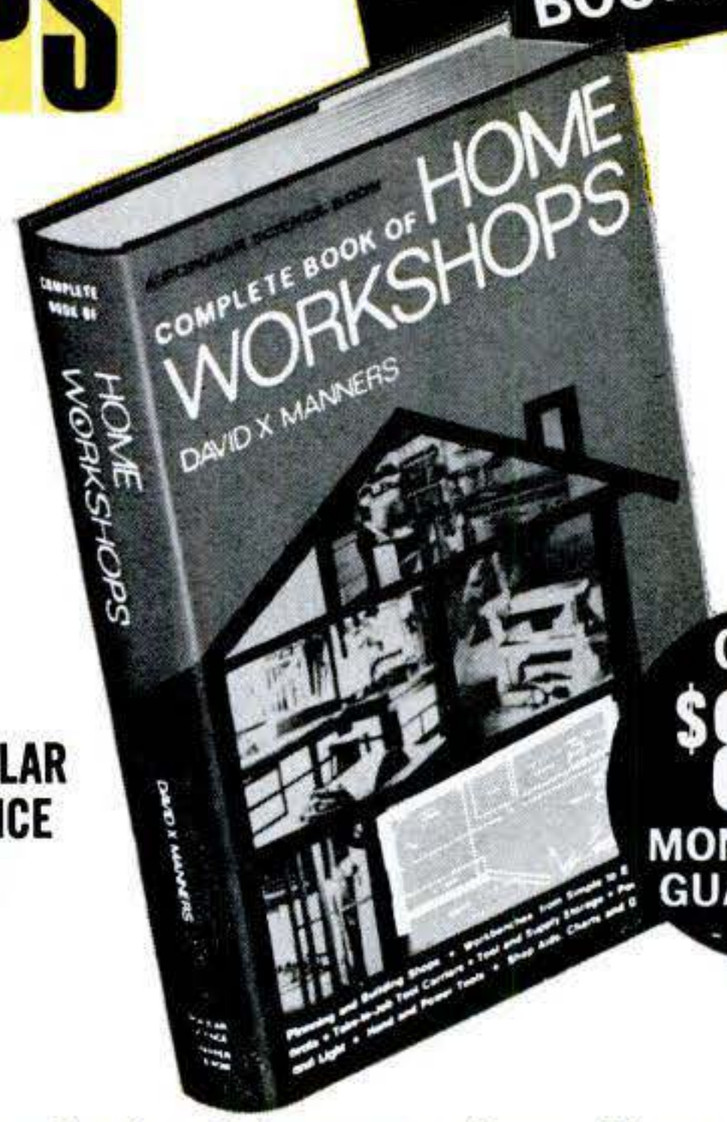

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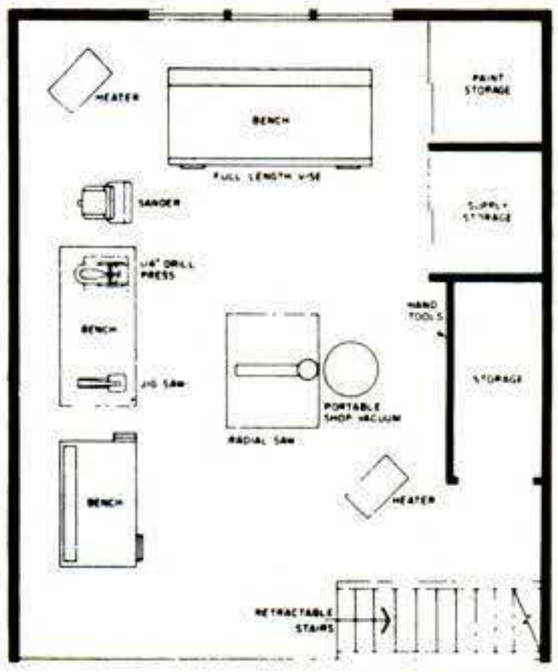
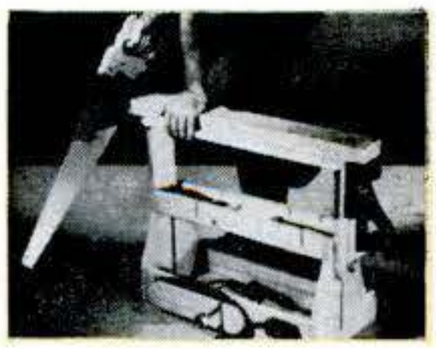
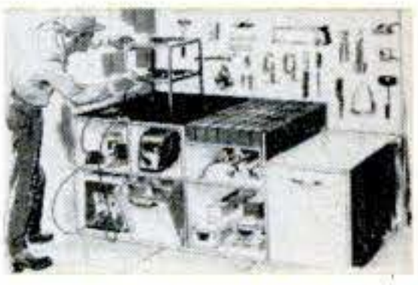


Floor plans like this make it simple to design a shop for any room in your home.



Portable shops range from leather holsters to this traveling assistant you can build yourself.



Bench for metal shop has three kinds of surfaces.

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A Heat Lamp for the Shop

[Continued]

ators; thaw frozen locks; soften plastics—including vinyl auto tops and wood-grained vinyl station-wagon trim panels—for shaping and bending. It will soften plastic seat covers for smoothing and forming corners. Use it for bending plastic tile: Remove tile by simply heating, then lifting with a putty knife.

The lamp will speed hardening of epoxies and certain glues. "Flaming" of maple or hickory is another use. Or you can heat-expand housings in order to make snug-fitting bearings slip easily into place.

It does get hot. Some practice is needed to judge how far away to hold the lamp and when to keep it moving to do various jobs.

One supplier says the lamp reaches 800 degrees in three seconds. Realistically, temperature is a matter of cleanliness of the aluminum reflector; distance; and the mass, reflectivity, and color of the object to be heated. I checked mine with a portable surface-temperature-indicating pyrometer. One inch away, it heated the thermocouple to 1,150 degrees in six seconds. The temperature was about 650 degrees at four to five inches, down to 250 a foot away. It charred a pine board in 10 seconds when held five inches away.

Being flameless, the lamp may be less dangerous than a torch, but it should be handled safely and be kept out of the reach of children. Keep it moving when thawing pipe and deicing windshields. The heat that thaws can also generate pipe-bursting steam and window-cracking shock. Keep the lamp a safe distance from combustible materials. Dark glasses (supplied) must be worn to protect your eyes.

The Torchlamp is made by Smith Victor Corp., Griffith, Ind. 46319, and sells for about $30 with metal case, $25 without case. You can buy it through hardware, paint, and boating firms. Replacement bulbs are about $12 each. PS

Similar movie lights by Bell & Howell, GE, Smith-Victor, and Logan use the same bulb, could easily be adapted for heat-gun use.

New Gear for Trail Camping

[Continued from page 80]

you care to, thanks to the broad range of backpacking gear now available. Such major suppliers of general camping equipment as Coleman, Thermos, and Sears have now ventured onto the trail for the first time. The sampling of gear pictured (in four major categories) will give an idea of the range in sophistication and price. Suppliers are listed at the end of this article.

Don't break your back. As a general rule, limit your pack to one-fifth of your body weight. By trimming food, clothing, and shelter items down to essentials and shopping for the lightest equipment that will do the job you require, you should be able to get a week's provisions into a pack of that weight.

Sleeping bags. The first essential for overnight backpacking is a warm, comfortable "bed." If you already own sleeping bags (for use in your RV) you can, of course, just lash these to the bottom of your pack frames. But they're too bulky and too heavy for serious backpacking. The lightest and most compact bag for luxurious warmth is one packed with northern goose down. But synthetic fillers are half the price, and if you don't plan to camp at low temperatures these will suffice.

Mummy bags are tapered to conserve body heat, for temperatures down to below zero. As a bonus, trimming off those corners gives you a bag that's lighter on your back. If you want to cozy up with your hiking mate, buy a pair of non-tapered bags: Most can be zippered together.

What you place *under* the bag depends on your standards of comfort. At the least you'll want a waterproof ground cloth, probably a roll-up foam pad, or, best of all, a good air mattress (rubberized, not plastic).

Cooking gear. You can enjoy hot food and coffee in the wilds—even without a campfire permit—for an investment of around $2 for a can of Sterno and a folding stove. Anyone who scoffs at cooking with such humble gear simply hasn't tried it with the new freeze-dried foods.

The wonders of modern processing let you plan on only about two pounds of food per person per day. And that lets you eat in style. I'd guess the greatest misconception about backpacking is that the specially packaged trail foods offer only bleak subsistence. To dispel that notion, order a few items from the Stow-A-Way catalog—beef Stroganoff, maybe, or chicken Tetrazzini.

If you're a hunter or fisherman—or want to supplement the packaged food with fresh produce—you'll need a more sophisticated stove. You'll find a variety of ingeniously compact gear—mostly European imports—in the catalogs. Check cooking-gear, photo 3, (courtesy Moore & Mountain): At left is a cookset for two to four, featuring a Svea gasoline stove plus Sigg nesting pots. It all straps into a five-in.-high, eight-in.-dia. backpack unit weighing only 2¼ lbs. and selling for around $20. At right, same photo, is the Primus Grasshopper—a propane one-burner for summer use—shown attached to the replaceable cylinder (burns 7½ hours) and folded flat; without propane, $8.

Backpacks. The standard frame is aluminum tubing with canvas or nylon back bands to hold the load away from your sweaty back. Adjustable shoulder straps should be foam-padded nylon. The contoured frame should place the load high on your center of gravity so you don't need to lean forward while hiking.

If you're starting from scratch, it's best to buy frame and bag as a pair, to assure matching fit; there's often a saving over separate purchase, too. Sets come in graduated sizes scaled to your overall height.

Tents. There's a special breed for backpacking; since these tents must take the extra punishment of being put up and taken down nightly, they must be ruggedly made, yet weigh as little as possible. Most have sewn-in floors, which relieves you of packing a ground cloth.

Imports such as the Fjallraven Expedition model (tents, photo 3) tend to be expensive. This one's really two tents: An inner porous fabric can be zipped tight and still provide fresh-air circulation (no need for netted openings); the outer tent is double-coated to shed water. The air space between acts as an insulator to keep the tent cool in hot weather, warm in cold. Moor & Mountain also offers a 3¼-lb. two-man version for $70.

Where to write: Spring catalogs are just off the press—and are generally free. Here, listed alphabetically, are major manufacturers and mail order suppliers. Each has certain exclusive specialties. So if you're serious about equipping yourself, get several.

Eddie Bauer, 1737 Airport Way So., Seattle, Wash. 98124. **L. L. Bean Inc.,** 303 Main St., Freeport, Me. 04032. **Coleman Co. Inc.,** Wichita, Kans. 67201. **Moor & Mountain,** 67 Main St., Concord, Mass. 01742. **Sears** (nearest catalog store). **Smilie Co.,** 575 Howard St., San Francisco 94105. **Stow-A-Way Products,** Cohasset, Mass. 02025. **Thermos Div.,** King-Seely, Norwich, Conn. 06360. **Ute Mountain Corp.,** Box 3602, Englewood, Colo. 80110. PS

Comfort on the rocks. You get it with Jeep guts.

The Jeep Wagoneer— the first family wagon to give you 4-wheel drive safety off the road.

You've got to have a tough wagon when you're exploring with your family. A wagon with guts you can take for granted—even when you're crunching over granite.

The Wagoneer gives you more comfort and safety than you've ever experienced in any 4-wheel drive vehicle. It has a higher ground clearance and a lower center of gravity, too.

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Today, the Wagoneer has a rock bottom price to keep it the leading 4-wheel drive family wagon. See it at your Jeep dealer. And for options, choose anything from an air-conditioner to a snowplow. Everything from posh to push.

The toughest 4-letter word on wheels.

Jeep

Products from American Motors

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Two-Faced Tapes Do the Job

[Continued from page 95]

willingness to peel is an advantage where it may be desirable to remove or replace the material.

- Initial tack is unique among all adhesives except contact cements. Bring mating parts together and they stick instantly. However, there is usually a little "open time" for final adjustments, and the final grab doesn't come until you apply pressure.
- General overall strength is excellent if you don't expect miracles. In situations of heavy load, the adhesive has a tendency to creep. For this reason DC tapes are most useful in low-stress applications.

An extra hand in the shop. An extremely useful service of the tapes is holding components together while mechanical joinery is completed or other shop operations are accomplished. Several examples of this are cited by Charles Soriano, whose Swell Products Co., Fairfield, Conn., manufactures DC tape dispensers:

1. Fastening two pieces of strip steel together for welding.
2. Holding leather together for stitching or riveting.
3. Holding two or more pieces of stock (plastic, plywood, sheet metal, etc.) together for cutting all to one shape, and perhaps drilling all.
4. Fastening a boring jig or other master piece to stock when it is important to position holes identically on successive workpieces.

The shapes it comes in. The tape comes in rolls—barely worth mentioning, except for the fact that the material also is made in sheets, strips, and patches. To keep the stuff from sticking to itself, it is put up with separating strips. These are most often of paper coated with silicones—to which DC tapes will not stick.

In typical use around home and shop, you'll handle DC tape by unrolling a length with the parting strip in place. Position the revealed sticky face carefully on one of the joining surfaces, rubbing it into contact while the strip is still on the tape. Then peel off the parting strip, exposing the other sticky side. When you press the second joining member against the tape, the fastening is finished.

Use-and-handling tricks. Experience has turned up several for getting the most out of DC tapes:

- When sticking something small to something big, apply the tape first to the smaller part. Then use a razor blade to trim the tape to perfect shape and fit, *before* you peel off the parting strip. When the parts go together, the tape is invisible.
- Try for maximum contact between tape and surfaces. It helps to rub the strip with a thumbnail or rounded end of a ball-peen hammer to insure contact. This doesn't interfere with removal of the parting strip.
- Maintain pressure for a few seconds after the two parts are properly positioned. In some cases you may want to snug things up with clamp, to be sure the first contact is good.
- Don't over-use the tape in joinery where there is little stress. A strip around the perimeter of a large, light object will hold; you need not cover all joining area.

You mustn't expect too much from DC tape on wood. All it can do is stick to the surface fibers. When they tear loose the joint is finished. (Adhesion with liquid glues on wood depends on penetration, surrounding and bonding the fibers together.) However, adhesion to *painted or varnished* wood is so good that the tape will pull the paint off before it will release its grip.

Some of the odd-job versatility of DC tapes is reflected in the variety of things I've use it for:

1. To hold a shower curtain tight to the tiled wall at one end, licking a water problem completely.
2. To hold the nameplate on an old TR3 after repair plastic had built up the metal's thickness too much for standard screws. (Borrowed this idea from Detroit.)
3. To put a small mirror on the sun visor on the passenger side of the car, thus keeping the rearview mirror aimed the way it should be.
4. To add handcrafted numbers on the side of a rural mailbox.
5. To refasten a stitching-ripped zipper on some rain gear.
6. To mount a patch of glass over a broken window till I could get around to regular repair.

In short, whenever something has to be stuck to something, chances are DC tape will do the job quickly and conveniently.

Where do you buy it? Tapes intended for holding down carpeting, and strips intended for putting up pictures, are generally sold in hardware, paint, and houseware stores. And they'll do many additional jobs. For more specialized, tougher-job tapes, you may have to turn to tape specialists in the Yellow Pages.

Among big-name tape companies: 3M, Permacel, Mystik, Tuck, Dennison, Behr-Manning. Others are Kasen Industries, Newark, N.J.; Avery Products Corp., Painesville, Ohio; Arno Adhesive Tapes, Michigan City, Ind. Or write Swell Products, 123 Papurah Rd., Fairfield, Conn. 06430, for a list of brands they distribute. PS

Wheels for the Wild Country

[Continued from page 89]

on the smooth stretches. And since you sit only inches off the ground, it's faster than you'll want for rolling over bumpy terrain.

The Dunecycle will take a 42-degree hill and will keep its stability even when you're "coming round the mountain," crosswise of the steep angle. Handling is quick because this three-wheeler has a differential like a car. Lock one of its two separately controlled band brakes, power the other wheel, and it turns in its own length.

For go, there's a motorcycle-type twist-grip throttle. A kill switch is placed rather far from the throttle; inconvenient, to say the least, should it stick—as it did at one point while I was jockeying the vehicle around.

First of the three-wheelers. That was the Tricart. This new model with four-cycle engine ($715, plus $50 for electric start) is a versatile vehicle around the house as well as off in the wilds. Geared down for pulling power, it lacks the speed of the two-cycle-powered model. But it has more climbing ability, and can even do a creditable job as a utility vehicle in the backyard where it can pull a gang mower, or tow a garden cart for you.

The Tricart's four-cycle, one-cylinder B&S engine cranks out eight hp to give a 22-mph top speed along with plenty of low-end torque.

It has the same strange braking system as its two-cycle brother. You push the handle *up* to stop, which seems an unnatural motion to me. But there's a reason: Because you ride over bumps, there would be constant pressing down of the handlebars and much needless braking.

Honda's ATC ($595), latest of the three-wheelers, is much more substantially built than the Dunecycle or the Tricart. But it is also more demanding of control and less forgiving. In fact, getting used to handling it is tricky. The first time I climbed aboard and fed some gas, it reared up on its back wheels, then wound up on top of me.

This rig requires considerable body english to keep it stable when cornering or when you're accelerating rapidly from a standing start. But it also has surprising climbing ability, with lots of power to scamper up steep hills or through rough or swamp.

The Honda is powered by a six-hp, OHC single-cylinder, four-stroke. There are four forward speeds—two in low-range, two in high. You change speeds by depressing a pedal with your left foot. Changing from high to low range is accomplished with a simple hand adjustment. PS

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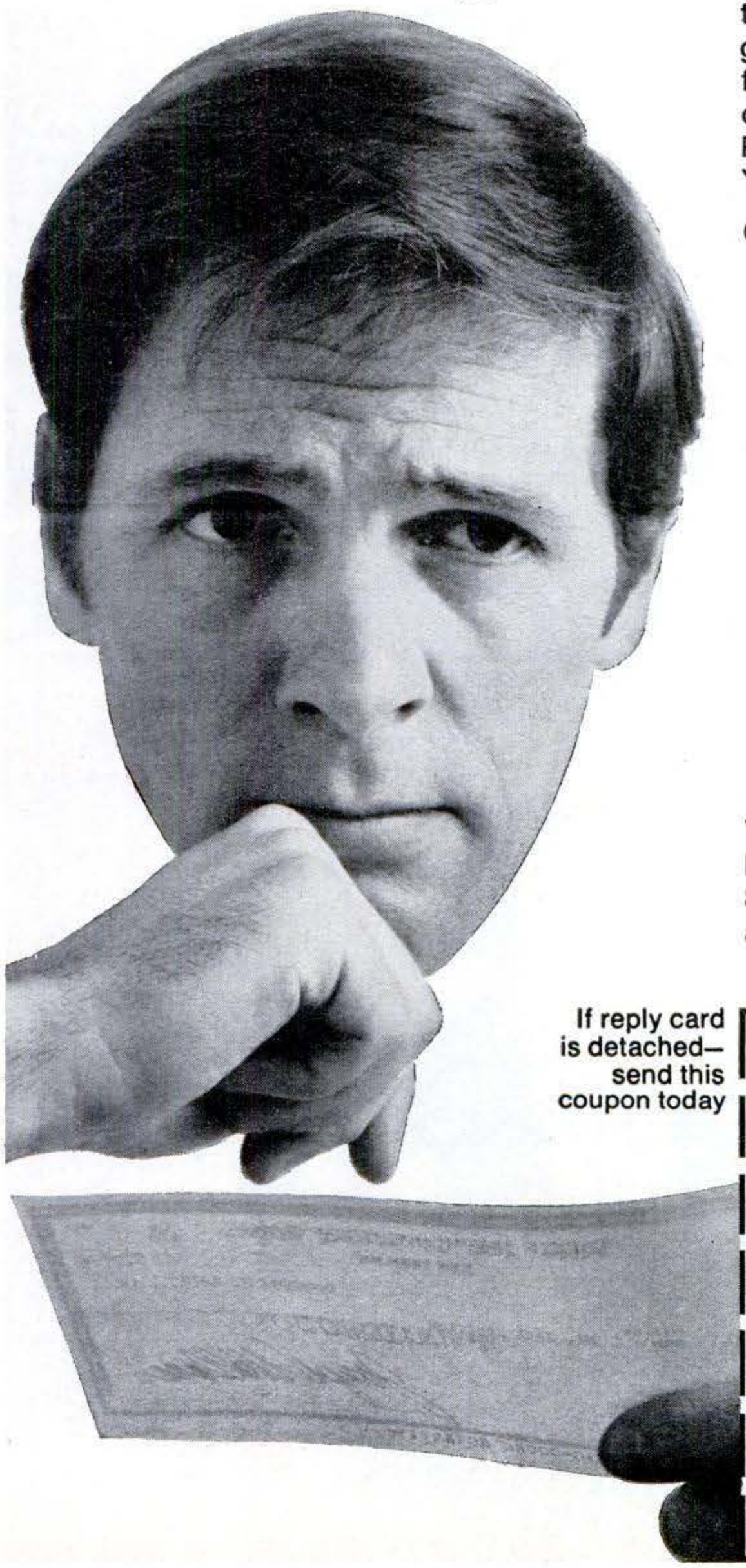
Your paycheck says a lot about you



It tells you more than how much you make. It tells you how far you've come. And if your paycheck looks very much the same as it did last year, or the year before, it simply means that *you* look very much the same as *you* did last year and the year before.

But times change, and you should be changing with them. Old dull jobs are disappearing. New exciting ones are being created. There are challenging new fields that need electronics technicians...new careers such as computers, automation, television, space electronics where the work is interesting and the earnings are greater.

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Our First Coast-to-Coast Interstate—the Campers' Expressway

[Continued from page 79]

State law tolerates higher speeds in the West than in the East. Iowa, Nebraska, Utah permit 75. Trailers are cut to 55.

hours of driving could be less than 60 hours, and when the last piece of paving is laid that can be sliced to 48.

I-80, successor to old Route 46 across New Jersey, Route 6 across Pennsylvania, and 30, 40, and 50 on west, is not toll free. You have to pay to cross one river, the Delaware, and I-80 in Ohio and Indiana incorporates the northern toll roads of those states, built some years ago. It takes a few pennies to skirt Chicago. As yet, I-80 is not without traffic lights.

How many miles? For its projected length of only 68 miles—from Teaneck to the Delaware Water Gap—New Jersey's part of I-80 is the least complete. Only 32.2 miles, in separated bits, are open. They're magnificent. But the detours are onerous.

Pennsylvania's segment of I-80 is a dream. The grades and curves through the Alleghenies are gentle. The scenery is sublime. For 95 of the 313 miles there's a telephone each half-mile. Through Ohio and Indiana the right-hand lane, where roughened by trucks, is annoying.

Illinois' I-80 is nonstop—all 163.5 miles are complete. So are Iowa's 292. Western Nebraska lacks 96 of its 455 miles, and poor signs require four eyes to get through Omaha. Only an uncompleted seven miles near Cheyenne mars Wyoming's 402 miles.

Utah's 194 (83.3 still to come) are on-again, off-again both east and west of Salt Lake City, with opposing traffic frequently routed onto two completed lanes. Then—bang—suddenly you are on 37 miles of a beautiful, four-laner that runs straight as an arrow across the Salt Flats to Wendover. Nevada has 92.6 miles to complete its 410. California's 115 are practically all down.

All the gaps on I-80 will be filled by 1975, a number of them this year. So far, the 2,900-mile highway has cost $2,380,000,000. The work remaining will boot this to a grand total of about $2,938,000,000.

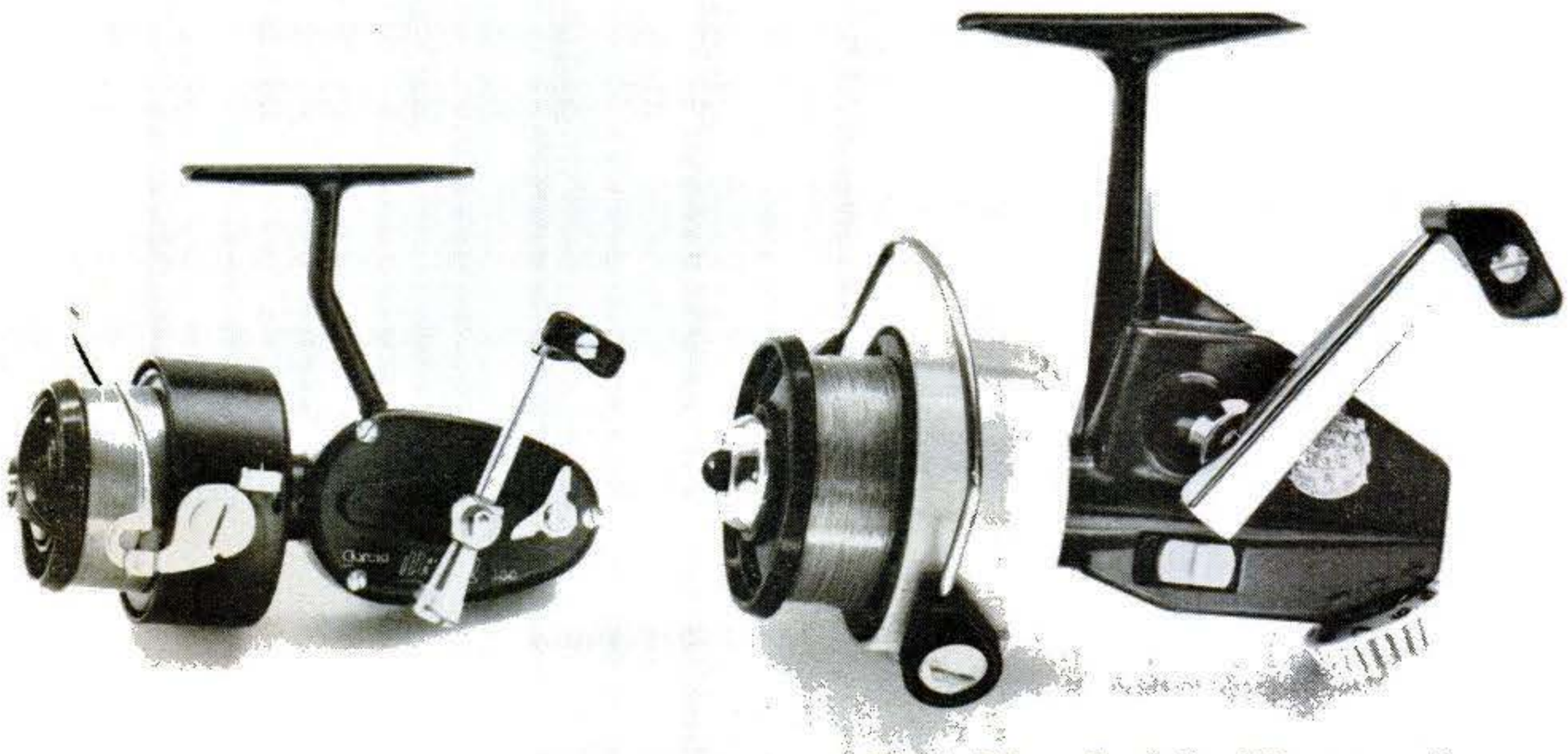
We get some shocks. New to trailering, we had done 60 mph through Pennsylvania and 100 miles of Ohio before a ticket girl on the Ohio turnpike said, "You're in the wrong lane. You're 'Trucks.'" She added, "You're limited to 55." There had been not a single sign anywhere. The guide book we had consulted said differently. Who's right? The Starcraft, incidentally, trailered beautifully at 70 with no wind.

Some miles short of Elko, Nev., I got on the C-B radio to inquire whether a campground called the Safari was still open. We rolled off at the designated exit. The campsite was as black as pitch. I was about to give up and re-enter I-80 when a pickup truck stopped behind the caboose. A man climbed out to shine a flashlight in our faces.

"Go ahead and camp, if you like," he said after studying us. "Lots of strange characters around these days. We got to be careful."

We were disturbed by the defacement of the landscape by billboards,

ZEBCO will



this is a great reel, but... **Cardinal 4 is Better!**

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especially in Nebraska and Nevada, notwithstanding all the jawboning in Washington on preventing the defilement of the Interstate.

The shocks were balanced off by delight. At a private campsite in Illinois, listed as open in late October, we were utterly alone in a virgin woods except for a hoot owl competing with the distant midnight wail of a locomotive. The electrical hookups worked. We stayed there going and coming, and twice left notes to the owner to bill us at home. We haven't heard from him to this day.

Ready to head out? A few tips:

Many western gas stations have sanitary disposal units.

California, Illinois, Indiana, Nevada, New Jersey, Pennsylvania, and Utah permit roadside camping, but the clatter of truck traffic is murder.

Gas up at spots where there are competitive stations. One lone gas pump in the desert charged us 48.9 cents for premium.

Your gross weight may be less than a Cadillac's, but on toll roads each extra axle costs you more.

Carry good maps with secondary roads in the boondocks well marked.

Double-check guide book on opening, closing, and "all year" dates of campgrounds. A phone call can save time and money. Indiana Dunes State Park was supposed to be open. After miles on a miserable road we found the entrance barricaded. PS

State		Number of sites	Price range	No. of facilities	No. with hookups
CALIFORNIA	Public Private	51 45	19—F, 32—XY to $4.50 $2 to $4.50	6—both, 1—S, 18—T, 26—0 42—both, 1—S, 2—0	2—both, 49—0 42—both, 1—E, 2—0
ILLINOIS	Public Private	6 17	2—F, 4—$1 $2.50-$3.50	4—T, 2—0 17—both	4—E, 2—0 11—both, 6—E
INDIANA	Public Private	6 22	$1.50 to $2.50 $1.25-$5	3—both, 3—0 17—both, 1—T, 4—0	4—E, 2—0 17—both, 4—E, 1—0
IOWA	Public Private	23 12	9—F, 14—50¢-$2.50 $2 to $4	8—both, 4—T, 11—0 12—both	3—both, 12—E, 8—0 12—both
NEBRASKA	Public Private	21 20	18—F, 3—50¢-$1 $2-$3.50	1—both, 1—T, 19—0 16—both, 3—T, 1—0	3—both, 3—E, 15—0 19—both, 1—0
NEVADA	Public Private	8 27	1—F, 7—XY $1.50-$5	1—both, 2—T, 5—0 26—both, 1—T	1—E, 7—0 26—both, 1—0
NEW JERSEY	Public Private	3 6	$1.50 $1.50-$4	3—0 2—both, 4—0	3—0 3—both, 3—0
OHIO	Public Private	8 34	4—F, 4—XY $1.25-$4	1—both, 5—T, 2—0 30—both, 2—T, 1—S, 1—0	2—E, 6—0 25—both, 9—E
PENNSYLVANIA	Public Private	5 20	$1.25-$1.75 $1.50-$4.50	1—T, 4—0 20—both	5—0 19—both, 1—E
UTAH	Public Private	50 17	All XY $1.50-$3.50	1—both, 14—T, 35—0 17—both	1—E, 49—0 16—both, 1—E
WYOMING	Public Private	11 28	4—F, 7—XY $1-$3.50	11—0 27—both, 1—0	11—0 27—both, 1—0

GUIDE TO I-80 CAMPSITES

The sites listed are only those offering reasonably easy access from the highway. "Facilities" cover only flush toilets and showers. "Hookups" cover only water and electricity. Practically all sites will accept pets on leash. E—electrical hookup only. F—free. S—showers only. T—toilets only. XY—permit is required or payment of small fee.

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OFFER REPEATED BY POPULAR DEMAND!
In Spring, 1970, we made this offer and invited fishermen to compare Cardinal 4 with the current best seller.

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Yes! I want the better deal on the better reel! Enclosed is my sales receipt along with the two end flaps from my new Cardinal 4 reel box...or the top portion of my Cardinal 4 Reel/Rod combination package. Please send my check for $2.00!

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ADDRESS _____

CITY _____ STATE _____ ZIP _____

Offer expires June 30, 1971.

Coupon redeemable only on Cardinal 4 Reels purchased on or before June 30, 1971. Offer void where taxed or limited by law.

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COMPARE CARDINAL 4 TO THE CURRENT BEST SELLER. SEE... FEEL... HEAR THE DIFFERENCE! And notice these exclusive Cardinal 4 features.

(1) Stern Drag has ten calibrated click stops. Easy to operate while playing a fish. Six braking surfaces for smooth power. No comparable drag on any competitive reel. **(2) Anodized and Enameled Finish** is double tough, twice as handsome. **(3) Two Bail Springs** give perfect bail action every time. No loss of fishing time if a bail spring breaks. **(4) Swedish Stainless Steel Worm Gear** is precision milled and supported at both ends for perfect alignment. **(5) Stainless Steel Ball Bearings** for super-smooth, quiet running. **(6) Cardinal 4 is guaranteed by Zebco...** you can't say it any better!

Facts are facts, but there's no proof like your own experience. Take a Zebco Cardinal 4 out where it belongs and hang into an old mossback. Then you'll know. **Cardinal 4 is better!**

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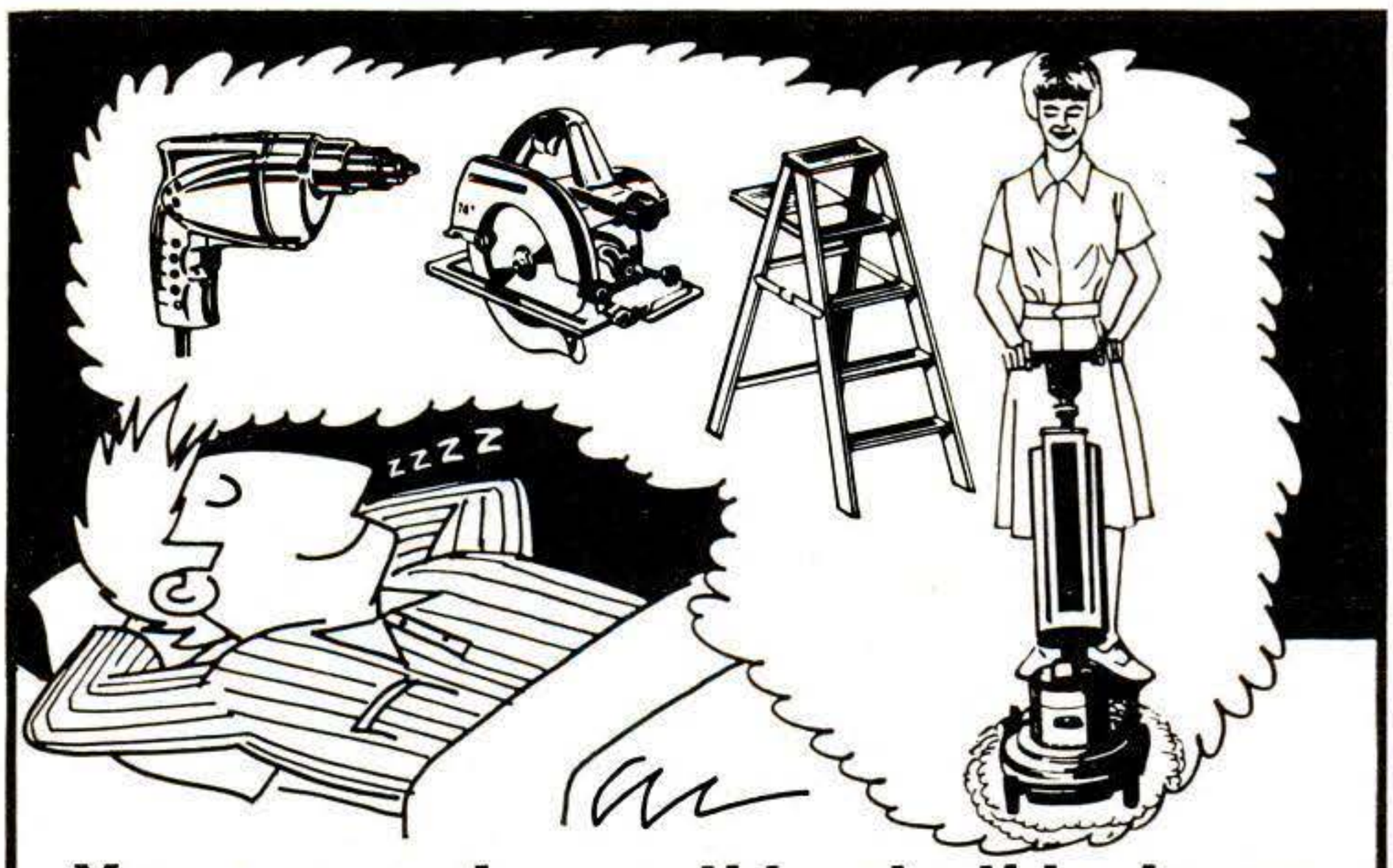

You can rent everything in this dream except the doll at the right

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See-While-You-Talk Phone

[Continued from page 65]

tion over wiring and switching networks requires very little transmission "space"; a bandwidth of about four-kHz is used for your voice. But the information carried by a Picturephone video signal is 250 times greater, requiring a one-mHz bandwidth.

This high-frequency video signal, although different from the TV signal passing through an antenna wire into your TV set, can be affected like a commercial TV signal: It's susceptible to ghosts, outside electrical interference, and signal loss on a wire pair designed for a four-kHz signal.

To minimize these problems, equalizers are installed every 6,000 feet on the video lines. These units restore the video signals to their proper level and correct distortion. This "trimming" of the wire-pair transmission characteristics is so critical, the equalizers must be regulated for seasonal temperature variations. A five-degree change in cable temperature can badly distort a video signal. Part of an equalizer compensates for temperature changes by monitoring a one-mHz tone fed continuously along the line.

Another problem for the one-mHz video signal can come from powerful AM broadcasts. The 0.5-to-1.6-mHz signals overlap the Picturephone's video signal; special filters and shielded drop wires are being used.

For Picturephone transmissions less than six miles, the picture and audio signals are in analog form. To send a call beyond six miles, the signal is converted from analog to digital form. The fluctuating amplitude of the analog video signal is sampled 6.3 million times a second, and the video is encoded into a stream of digital pulses.

The signal, which is now either on or off instead of a continuous range of values, can be transmitted great distances without distortion. All that's necessary is for the receiver and decoder at the other end to recognize an on/off state. This technique introduces some graininess into the picture, but makes it economically possible to send Picturephone signals great distances.

For several years microwave radio and various coaxial-cable systems will carry Picturephone signals between cities. A video signal can be fed to a multiplexing terminal and mixed with two other Picturephone signals. A single radio channel then carries all three signals.

Bell is now refining a color Picturephone that will work with the system. Research is also underway on 3-D pictures. PS

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Pinto... Ford's little import-size car. Compare it to VW...

Our little Pinto is built simpler—to save you money. There's less to go wrong. (And it's easier to fix if something does.) Pinto calls for half as many oil changes as VW. One-sixth as many chassis lubes. Pinto's brakes are self-adjusting. And that's just for openers! Pinto has a 75-hp cast-iron engine. The biggest VW Beetle, a 60-hp aluminum engine. Pinto has precise rack-and-pinion steering, like many expensive sports cars. VW doesn't. And Pinto is lower and wider, to hold the road better. You get more room on the inside. And Pinto's all-steel body is welded together as a single rattle-proof unit. See Pinto, the little care-free car. The choice is simple!

Maverick... America's most trouble-free compact. Compare it to other compacts like Vega...

We call Maverick, the simple machine because it's simple to own, simple to drive, and simple to take care of. According to a recent independent survey, Maverick has the best frequency-of-repair record of any American car. Just compare it. Maverick has a powerful 6-cylinder 100-hp engine (and an optional V-8 as well). Vega has 4-cylinders. Maverick's wheelbase is longer. And Maverick's track is wider. It has 15% more trunk space than comparable Vega models. Calls for fewer oil changes and lube jobs. Maverick also allows you simple "Do-it-yourself" servicing. And there's a 4-door Maverick, too. But there isn't a 4-door Vega. Maverick. It's that simple.

HANDY COMPARISON CHART

PINTO[1]	VOLKSWAGEN[2]		MAVERICK[1]	VEGA[3]
$1919	$1985 (Super Beetle)	**Price***	$2175	$2091—2-dr sd. ($2197—2-dr cp.)
94.0"	95.3"	**Wheelbase**	103"	97.0"
163"	161.8"	**Overall length**	179.4"	169.7"
69.4"	62.4"	**Overall width**	70.6"	65.4"
50.1"	59.1"	**Overall height**	53.0"	51.9"
55.0"/55.0"	54.3"/53.3"	**Track width Front/rear**	56.5"/56.5"	55.1"/54.1"
31.5'	31.5'	**Turning circle**	36.9'	33.0'
2030 lb.	1918 lb.	**Weight (curb)**	2626 lb.	2202 lb.
97.6 cu. in. 75 hp	96.6 cu. in. 60 hp	**Engine size hp**	170 cu. in. 100 hp	140 cu. in. 90 hp

1) Ford's suggested retail price excluding dealer preparation charges (if any), destination charges, state and local taxes. However, the above cars are illustrated with whitewalls ($29), and exterior decor option (Pinto $60, Maverick $52). 2) Manufacturer's suggested retail price East Coast Port of Entry. (Retail price may vary depending on P.O.E.) Dealer preparation charges, destination charges, state and local taxes are not included. 3) Manufacturer's suggested retail price. This price includes dealer preparation charges. However, it does not include destination charges or state and local taxes. *Based on a comparison of manufacturer's suggested retail prices for lowest-priced 2-door models, comparably equipped.

FORD

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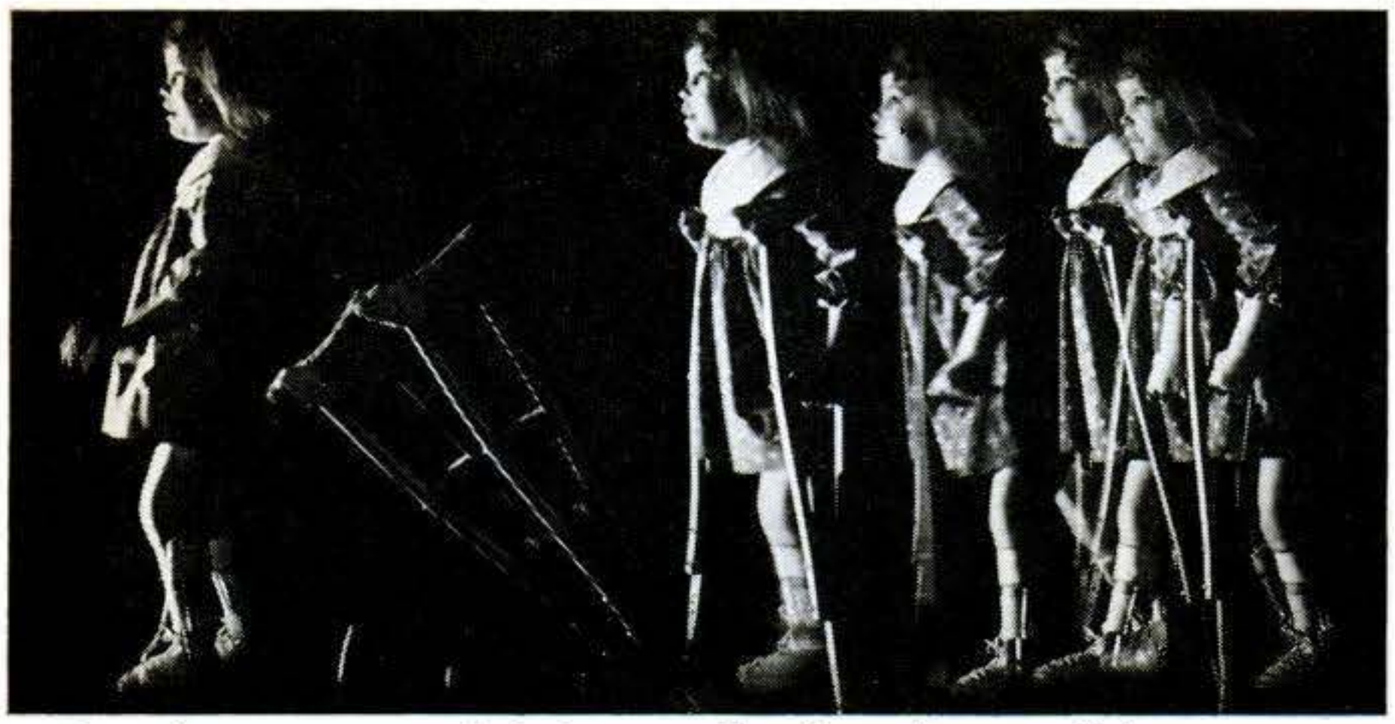
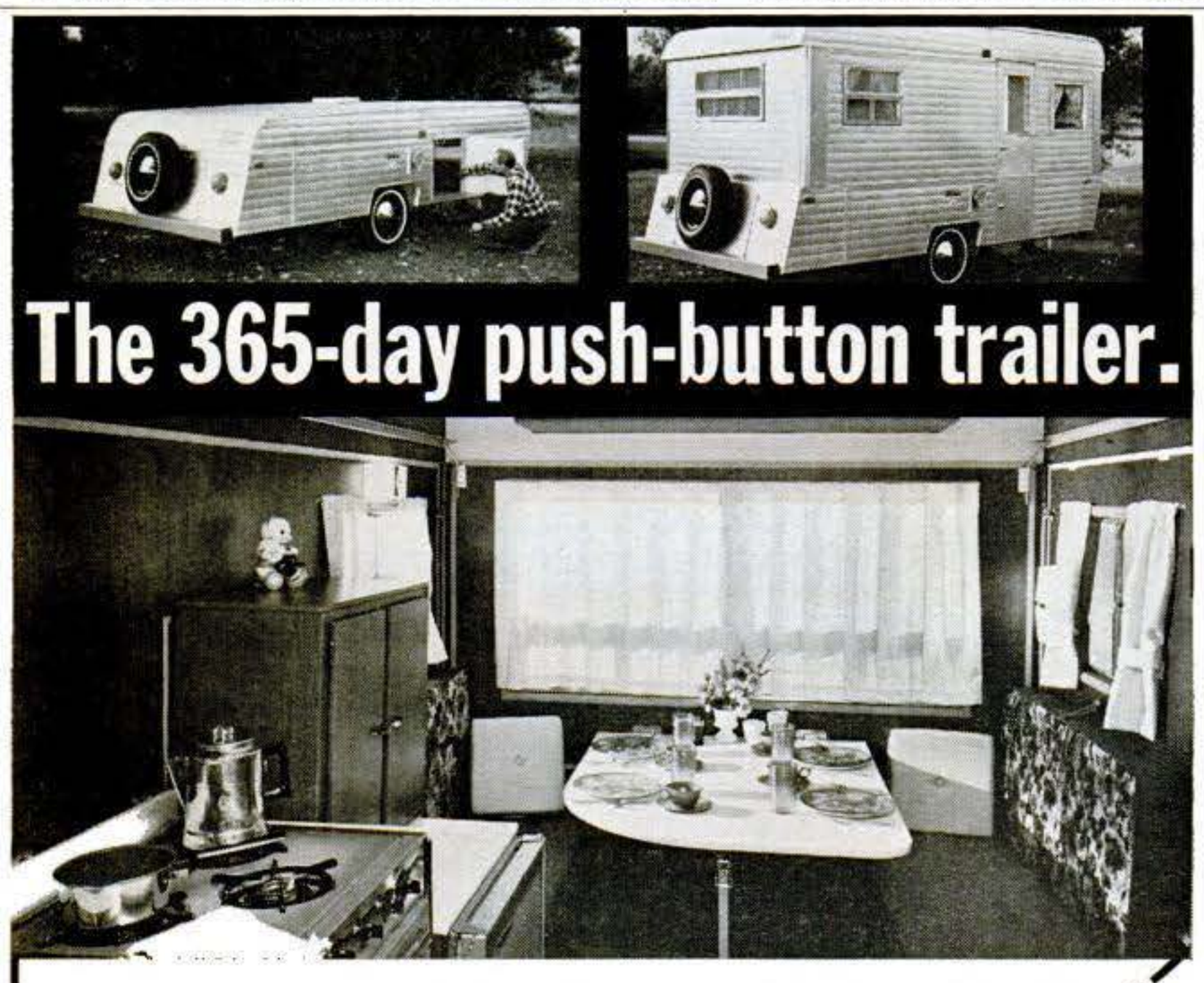


Our therapists teach kids to walk when they can't learn by themselves. And when their parents can't teach them. We teach kids to talk. We teach kids to hear. To control arms, and fingers. To move legs. Toes. We take little kids that are imprisoned inside themselves and help set them free. It takes money. Give to Easter Seals. Easter Seals: c/o Your Local Postmaster



Rolite makes camping all year round (on trips or in your own backyard) as easy as a push-of-a-button. It's the original solid-wall trailer that folds down like a soft-wall camper for safe, economical towing and easy storage. Push a button and in just two minutes it's ready for living—fully insulated, water-proof, dust-proof, weather-proof. Complete with gauchos, dinette, sink, 12/110 V. wiring. Write for details.

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Mating Camper and Pickup

[Continued from page 75]

wheel weight was 3,260; rear was 5,480. This equates to a ratio of 37.3 and 62.7 percent—very satisfactory.

To smooth out handling and eliminate freeway hop, we installed a set of shock absorbers under the front of the camper. We used Camper Dampers by Blackstone Mfg. Co. in Chicago. Two points of caution: Shocks should not be installed until *after* all weight distribution ills are corrected. Using them to correct other mistakes can only lead to trouble. We mounted ours (as the manufacturer recommends) on the side of the cowl and not on top. Many camper owners who have done the latter have experienced screws pulling out of the brackets and metal working up and down until a patch of cowl broke out.

Performance tests. To check the rig's handling we enlisted the aid of Jim Dunne, PS Detroit Editor. We used the same tests that he and Automotive Editor Jan Norbye use regularly for cars. Acceleration, even with the heavy load, was good; but braking tests brought the biggest surprise. The front power disks introduced by Chevy this year—and made standard equipment—proved to be outstanding. After 10 warmup stops from 60 mph at one-minute intervals, we made the test stop to check for fading. We stopped in under 150 feet!

In the lane-change test, the camper is considerably slower than a passenger car—and even slower than an ordinary pickup truck. Body roll is severe, even on easy lane changes.

The last phase of the test was a one-week road trip covering 1,012 miles of interstate and 264 miles of non-interstate. We drove at speed limits whenever possible.

The first tank of gas was consumed at a rate of seven mpg and got progressively better to 9.3 per tank near the end of the trip. We had the regular 20-gallon tank and found it a nuisance to buy gas so often. As a dealer option, Chevy offers a pair of saddle tanks that carry 37 gallons more.

The 9,000-pound GVW rating appears to be conservative. Our total weight was just at a point of engaging the auxiliaries. We felt we could handle another 500 pounds easily.

For emergencies. It's a good idea to equip yourself with wrenches, screwdrivers, and pliers, plus a tire-pressure gauge. Once you've assembled the tools, use them. Check camper hold-downs, LP connections, and tire pressure often.

Last, get a pair of fire extinguishers—one for the cab, one for the camper. You only have to need one once to become a believer. PS

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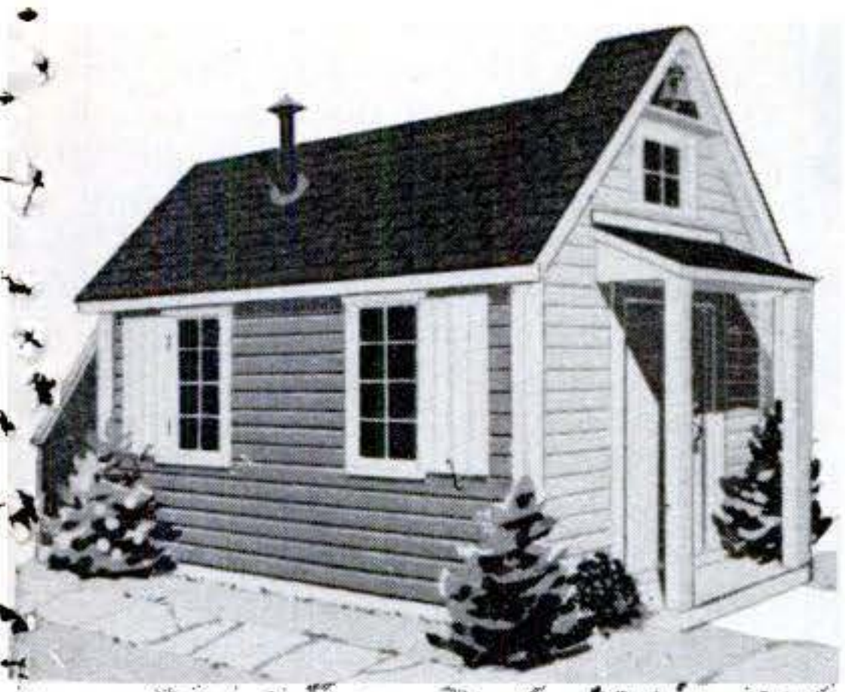

A LITTLE ONE-ROOM SCHOOLHOUSE for backyard storage and fun

Need a place to keep a riding mower or garden tractor? Would your youngsters like a really novel playhouse? This replica of a 17th Century one-room schoolhouse can serve either purpose—or both. Styled after a school built by the Dutch on Staten Island about 1690, it sits on a concrete slab measuring eight feet by 12 feet—a great size for either yard-equipment storage or outdoor play. Easy to build. Requires a minimum of materials to keep cost down.

Top it off with a ship's bell in that novel peaked belfry to call the gang together!

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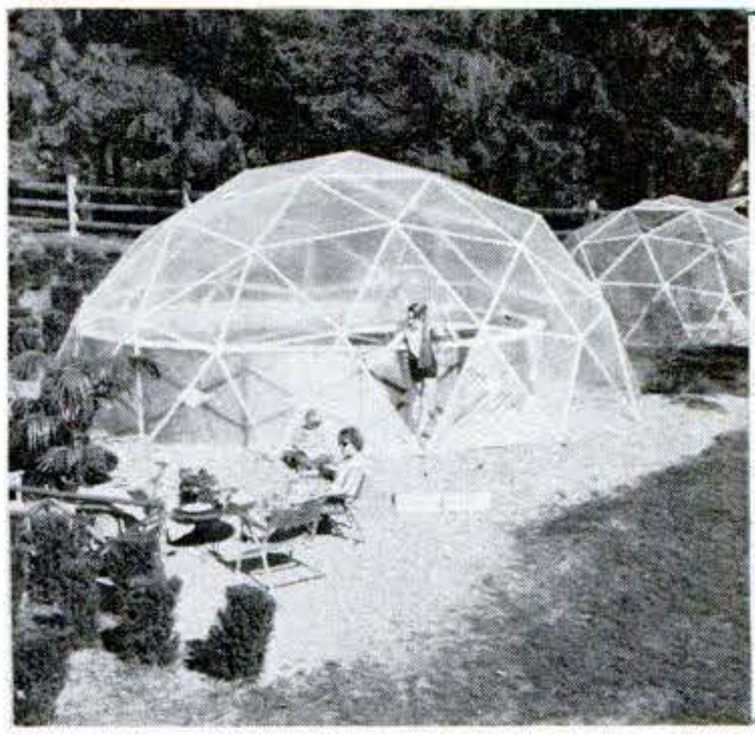

A PLASTIC SUN DOME to warm your swimming pool

What you build actually is a geodesic dome, patterned after the unique structure conceived and patented by world-famous architect Buckminster Fuller. Along with the plans, you get a license to build one of the domes, in various sizes, ranging from a diameter of 16-feet up to about 32 feet. Most builders have used the domes over circular swimming pools. Or build a small one for use as an inexpensive greenhouse.

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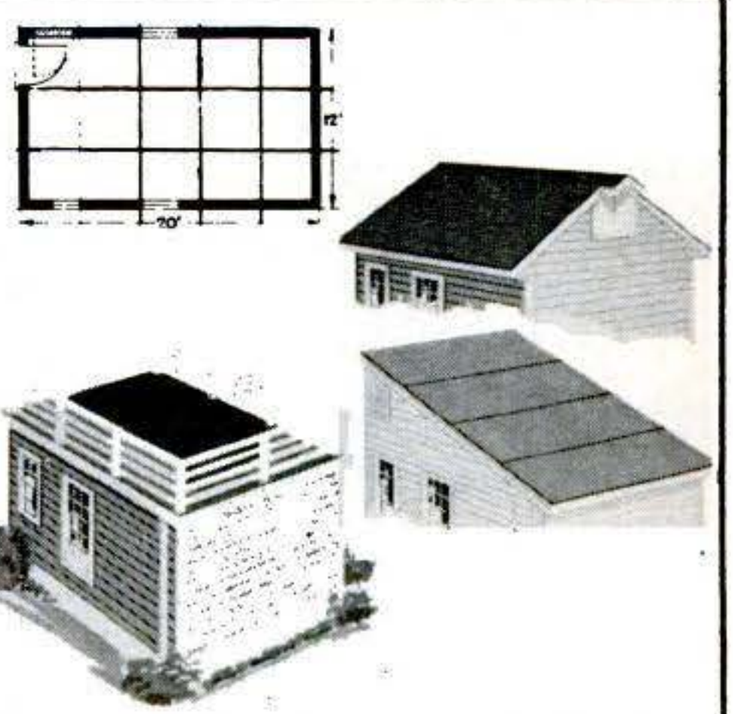

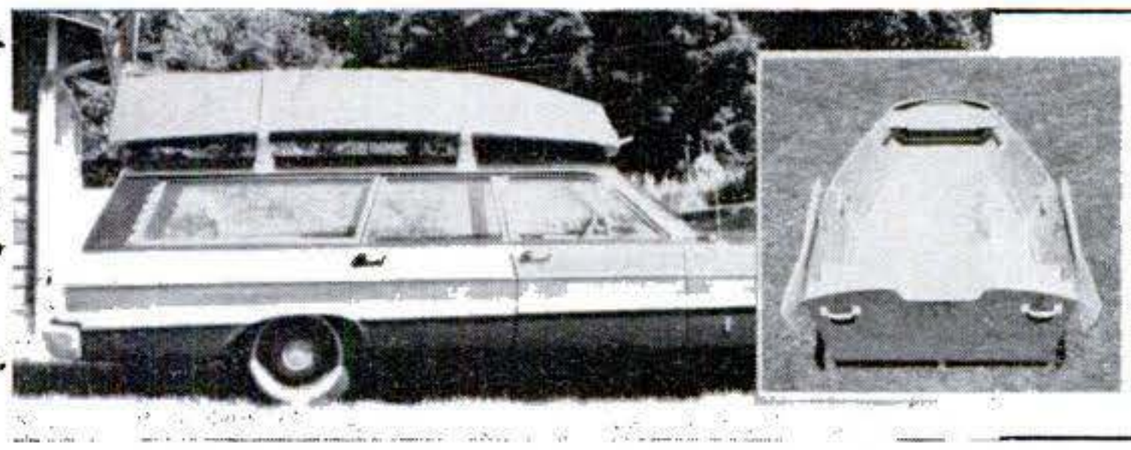

10-FOOT CAR-TOP BOAT . . . build it for a song

Ten feet long, 44 inches wide across the transom, built largely of inexpensive plywood, it cost the designer-builder less than $20 several years ago, not counting oars, seam tape, and paint. Turned turtle on a station-wagon roof, it fits neatly over camping equipment. Row it . . . or clamp on a 3 hp outboard for fishing or family fun. Get the boat plans FREE when you buy one of the other plans shown here, or buy the plans alone.

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HARDTOP TENT CAMPER for a happy vacation at less cost

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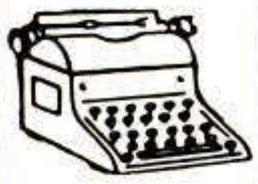

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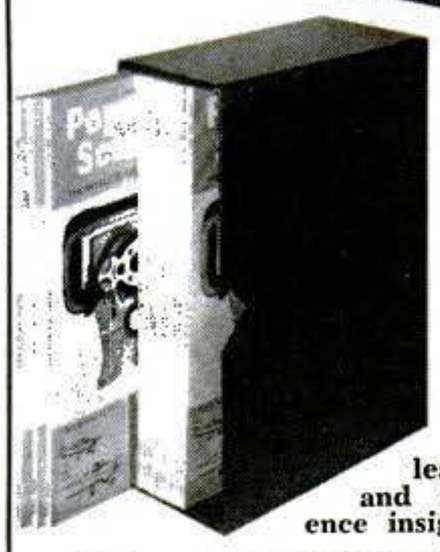

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Science Speeds Your Mail

[Continued from page 55]

ers. "You stand and look, and it's just like water flowing," Faught says with quiet admiration.

On the other hand, he likes the machine because it does use people to do the coding. Right now, the OCR can't match human performance, so the fancier equipment would look better but do less. When the OCR is ready, it can be inserted in the system with minimum modification. "That's a major advantage of the system," says Faught. "It can take advantage of better components at any point."

One prospect Faught thinks promising: taking the burden of final sorting off the letter carrier's back. Even when your mailman picks up his individual bundle from the sorter, he still has to arrange the mail in sequence to match the houses on his route. Can a computer program master all the individual peculiarities of each route and sort mail into final delivery sequence? Faught thinks it can—eventually. Right now, he'll settle for what he can get from existing equipment.

The same flexibility of thinking marks Faught's approach to other post-office problems. For example, bulk mail—packages and such—makes up only 1.4 percent of postal volume, but it consumes 11 percent of postal man-hours and a third of post-office space. Letters may vary in size, but at least they're all rectangular and relatively flat; packages come almost any shape and size.

Shunting the bulk mail. Instead of plumping for exotic machinery to handle this exasperating variety of mail, the post office is trying something much simpler. Special bulk-mail centers are being built to get packages out of the way of letter mail. Simply isolating the packages can save a lot of money, Faught says; after that's done, he'll worry about special bulk-mail machinery to increase the savings.

Next step: fluidics? This new discipline uses "fluids," such as air, in computers, control equipment, and transportation systems. Fluidics holds out one enormous advantage to the post office—relatively few moving parts. If mail can be moved on a conveyor belt, chances of a catastrophic mechanical breakdown are decreased.

So why not have a fluidic canceling machine instead of the present mechanical cancelers? Not right now, Faught says; the fluidics machine works beautifully when all the letters weigh the same, but the occasional

Continued

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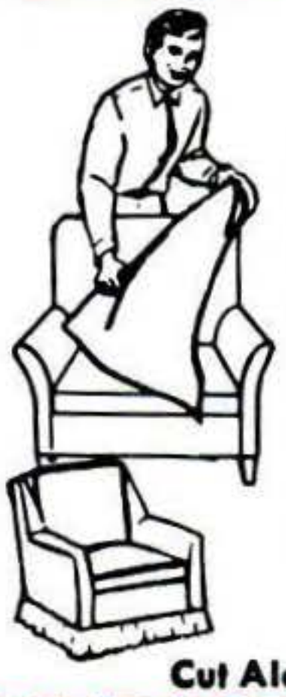

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Science Speeds Your Mail

[*Continued*]

heavyweight (with coins inside, for example) really messes things up. So the more prosaic mechanical canceler is also more practical.

But Faught points out that this quirk of fluidics can be put to practical use. One bright possibility is a fluidic device to separate light letter mail from heavier packages and bulk mail. The letter would literally float away on air, while the heavier, nonfloating items would be shunted off in another direction.

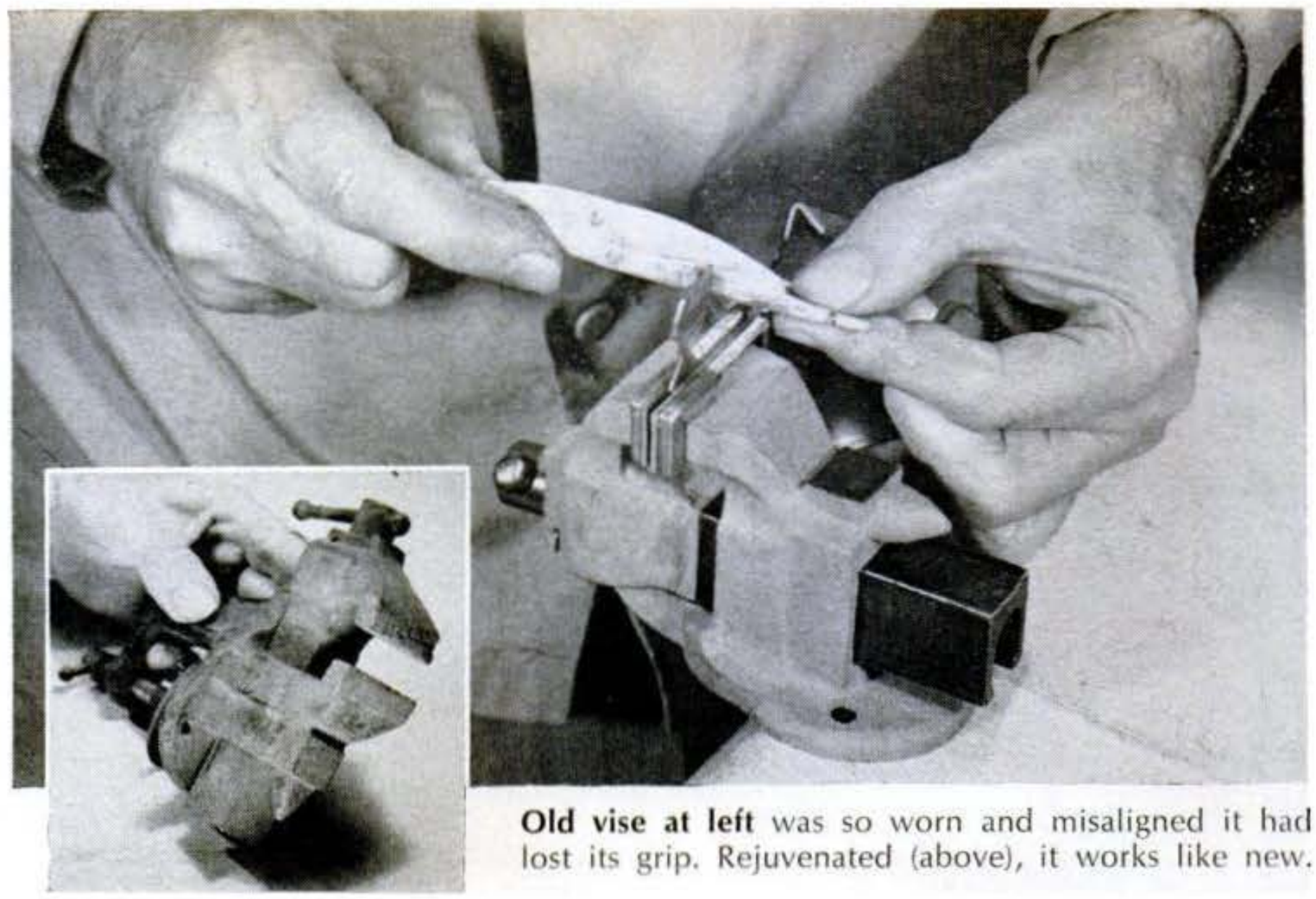
The key to the new post-office approach is this combination of practicality and new equipment. The equipment is welcome, but it must fit into the system as a whole. Faught tells of a study by a major corporation that showed that a voice-reading machine could speed up the sorting of packages. "It was a very interesting engineering development, but it did not pass the test of return on investment," he says. "It would need more extensive automated gear than would be worthwhile."

But the post office isn't overlooking any bets. It has nearly 200 contracts with industry. They range from programs to develop unbreakable stamp-vending machines (to shorten those slow-moving lines at the stamp window) to laser television systems for reading addresses. But it's the system as a whole, not any individual gadget, that gets priority.

Some advances are amazingly simple. Until recently, big post-office buildings had broad, imposing flights of stairs that added considerably to their dignity. A study showed that a surprisingly large number of people walked out the door reading letters—and fell down the stairs. Result: no stairs on new post offices.

All the new techniques have one aim in mind: to save money. The post office ran at a $1.1-billion deficit last year, but the new Postal Service is committed to breaking even. Faught's goal is to save a stunning $2 billion a year, or $6 million every working day. That's quite a goal, considering that the post office has to run fast just to stand still; if present methods are continued, estimates Postmaster General Winston M. Blount, postal employment would increase from the present 728,000 people to more than one million in a decade.

Faught believes it can be done—not by any magic ingredient, but by a combination of good sense and good technology. The mail, he says, will go through, mechanically, electronically, or by hand, but with increasing speed and efficiency. PS



Old vise at left was so worn and misaligned it had lost its grip. Rejuvenated (above), it works like new.

New Jaws for an Old Vise

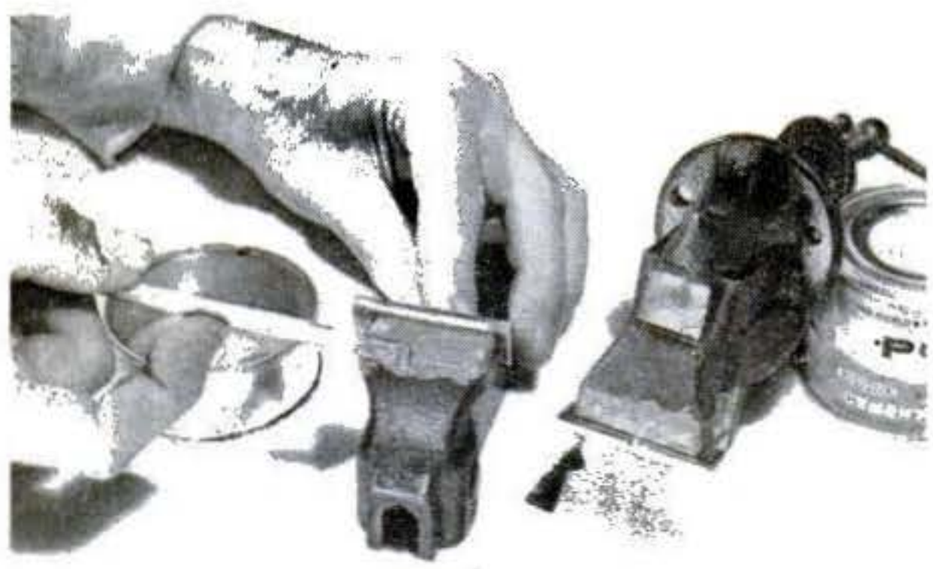
By WALTER E. BURTON

Years of carelessness with hacksaws, hammers, and files can ruin the grip and appearance of an old vise.

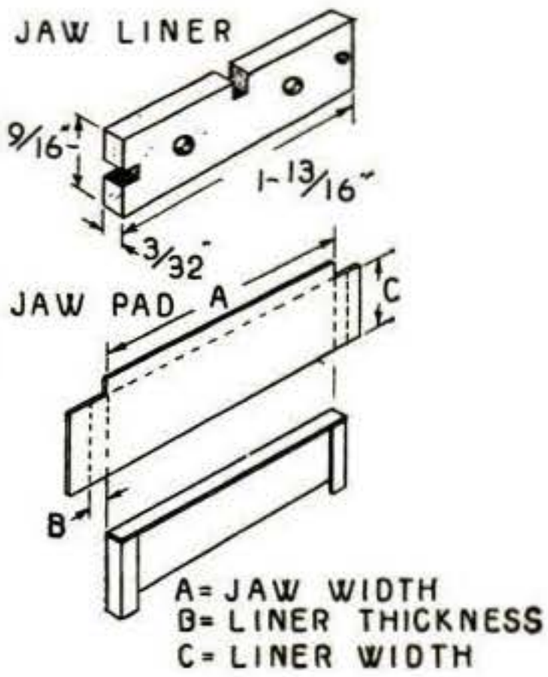
A set of steel liners screwed to the old jaws can restore the grip. To improve appearances, fill scratches and dents with epoxy putty, sand smooth, and apply two coats of paint. Clean and oil working parts.

If you cut the liners slightly larger than the faces of the jaws, you can clip copper pads to them to protect delicate work from nicks and scratches.

Cut new liners to project about 1/8" past the edges of the jaws, attach them with flat-head bolts.



To restore jaw alignment, smear epoxy putty behind liners. Clamp jaws shut until the filler hardens.



Copper jaw pads protect highly finished work. Pair on bench are leather-padded for holding fine silver.

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Before You Buy 4-Wheel Drive

[Continued from page 77]

good chance of puncturing an oil pan or tearing up the underside of your vehicle. Skid plates—flat steel shields mounted underneath the engine and transmission—let a vehicle ride up and over an obstruction. Before you buy a vehicle, check to see that all vital parts (fuel-sediment bowl, oil filter, gear linkage, fuel and brake lines, tie rods) are well protected. If the roof is flimsy and you're serious about your four-wheeling, you might look into roll bars.

Transfer cases. Most four-wheel drives come with a two-speed transfer case that offers a high and a low range. Acting like a second transmission, it "transfers" the gear ratio selected at the main transmission through high or low range and then directs it (and power) to one or both axles. The shifter usually has four positions: "four high," "four low," "neutral," and "two high."

Four high means four-wheel drive, high range—used for normal driving in four-wheel drive.

Four low means four-wheel drive, low range—used when you need maximum torque at a very low speed. This would include moving heavy deadweight (snowplowing), creeping slowly up out of a rain-, snow-, or ice-slicked hole, or pulling stumps.

Neutral is used when you want to disengage the drive assembly completely and channel the engine's power into another piece of equipment, usually a mechanical winch.

Two high means two-wheel drive, high range—used for normal driving. A three- or four-speed transmission gives you three or four forward gears respectively in each of the two driving ranges.

Safety equipment. Going into the back country, of course, puts you a long way from the gas station (thus the need for auxiliary fuel tanks or jerry cans), and sometimes into some pretty precarious situations. It's a good idea to take along a small tool kit for minor repairs, a "come-along" if you carry no winch, a tow chain, and a first-aid kit. Some four-wheelers wisely insist on a fire extinguisher. A small shovel is often worth its weight in gold. Quartz-iodine lamps are a tremendous help in dark and unfamiliar territory.

What about stability? Argument is often made that 4WD vehicles are unstable. In a limited way, this is true. A solid front axle forces the engine, and thus the whole body, to be mounted higher off the ground. What you lose in stability, however, you gain in ground clearance. Unless the vehicle's track is excessively narrow or the center of gravity is very high (weight in a roof-mounted luggage rack would do this), stability is usually no problem.

Wheelbase. Most 4WD vehicles are built on short, 90- to 100-inch wheelbases. In general, a short wheelbase means better maneuverability in tight spots; a longer wheelbase means more room inside for people and gear. Bigger rigs, usually equipped with a V8, are better suited for towing.

Gross vehicle weight. Since a 4WD vehicle shares some of the heritage of trucks, gross vehicle weight (GVW) is a term you'll run into often. It represents the vehicle's maximum loaded weight. *Curb weight*, on the other hand, refers to the vehicle's weight less gas, passengers, and baggage. The difference between the two is *payload*.

A vehicle with a GVW of 4,000 pounds and a curb weight of 3,200 pounds has a payload capacity of roughly 800 pounds. That may not sound like much, but 800 pounds can easily account for four adults, a tank of gas, and a week's camping gear. GVW can usually be boosted with a heavy-duty suspension system, but you often pay for it with a stiffer ride.

Specialty options. The most sophisticated 4WDs offer highly specialized power-takeoff (PTO) equipment, used to drill wells, pump water, or run generators. Chances are you'll never need anything like that, but if you're even vaguely interested (building a cabin in an inaccessible area?) you might want it.

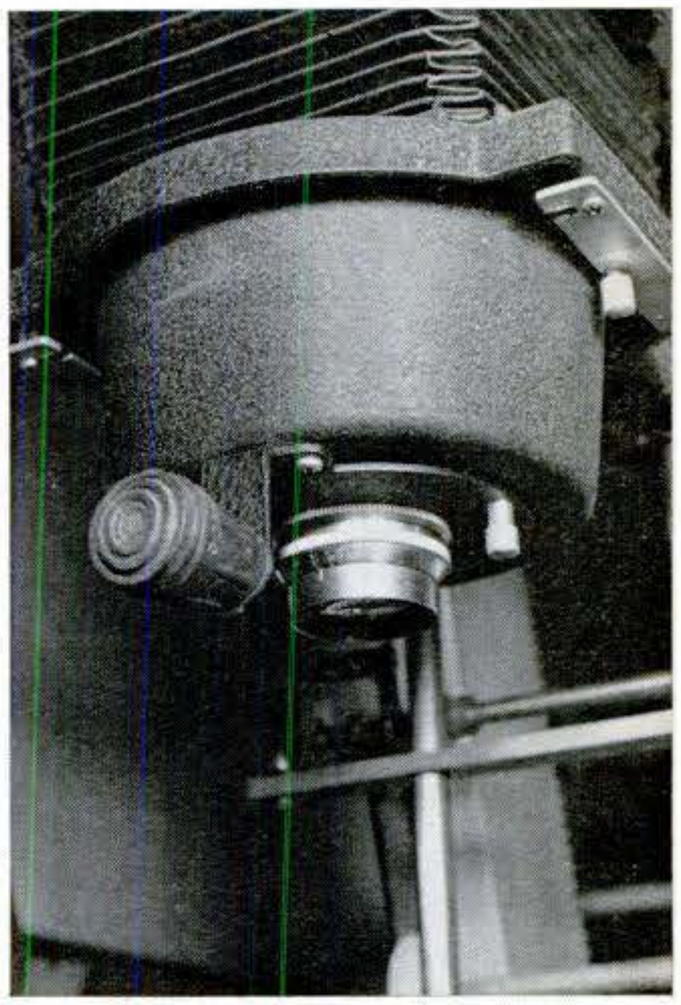
Snowplows and high-load-capacity hydraulic winches and lifts are also available, as well as oil coolers.

Keep these things in mind when you go looking for a 4WD and you'll not only be able to ask your dealer a pertinent question or two, but you're more apt to end up with the vehicle you're really looking for. PS

"I'm going to give you the best possible trade-in allowance on your car. How much gas in the tank?"

SHORT CUTS AND TIPS

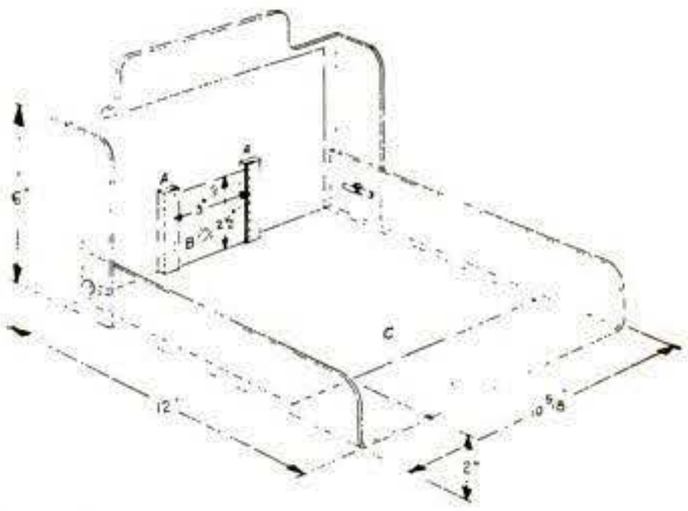
FROM PS READERS



For darkroom safety

While I was working under dim safelight conditions, the empty red-filter bracket on my Omega D-2 enlarger almost gouged my eye out when I bumped into it. Now I have crutch tips (number seven) pushed on the brackets of my various lens mounts. I take them off only when I want to use the red filter under a lens.

HARRY A. TUCKER
New Orleans, La.



Posing postage stamps

For making 35mm transparencies of postage stamps, I built this copying stand from a 16⅝"-by-20" piece of corrugated paperboard. I covered the floor and upright behind the copy holder with black paper, rubber-cemented down. The copy holder is just two 2½"-by-3" sheets of acetate taped together along the bottom. Copy-holder supports (A) were built up to about ⅛", using alternate layers of ¾"-wide strips of acetate and crepe-type masking tape. Outside layers are offset toward each other for a distance of about 3/16", forming lips behind which the loaded copy holder can be inserted for shooting the photo.

R. L. PEPPERBURG
Winter Park, Fla.

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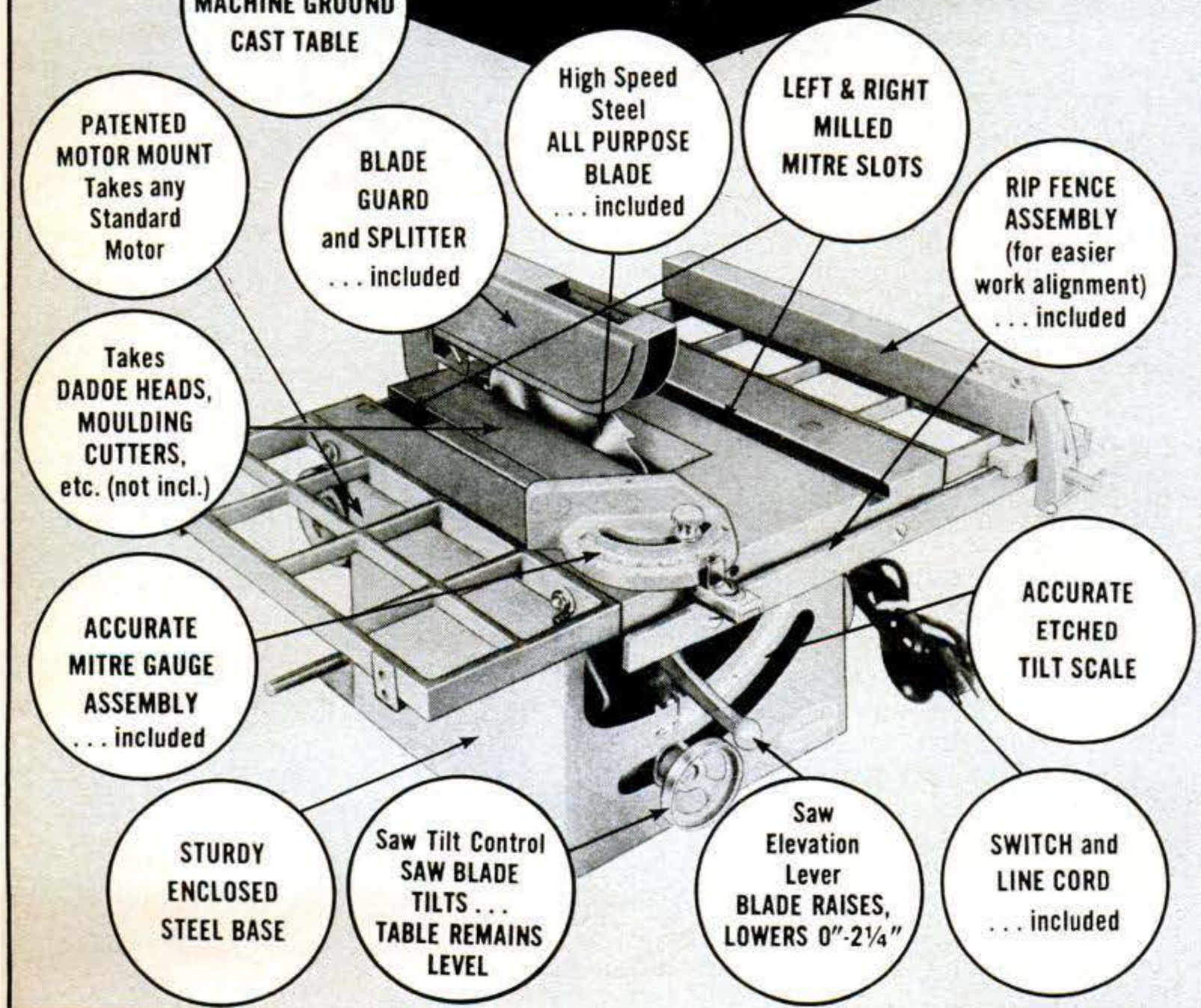

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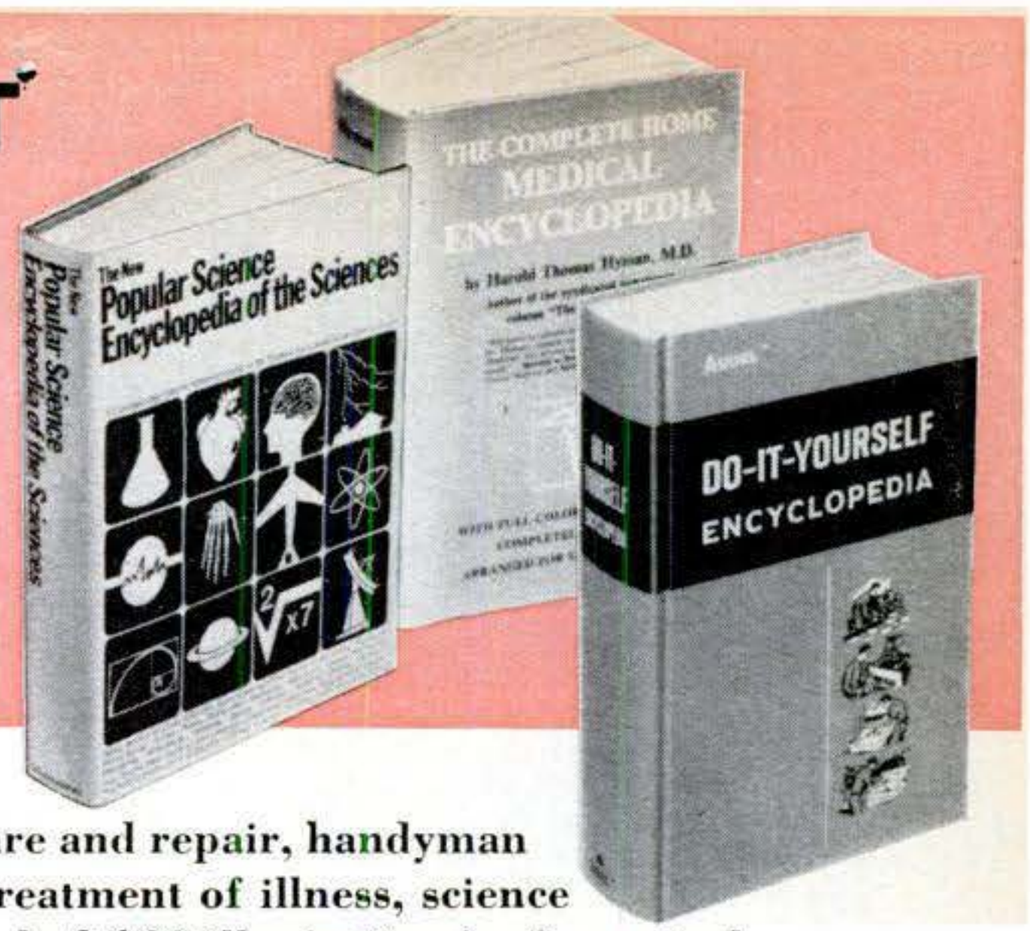

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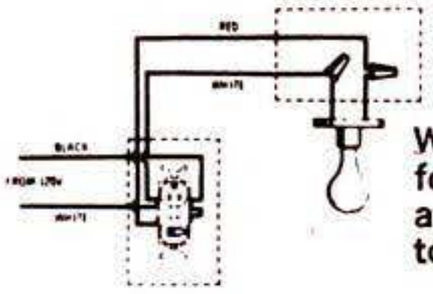

Wiring diagram for adding an outlet to a switch.

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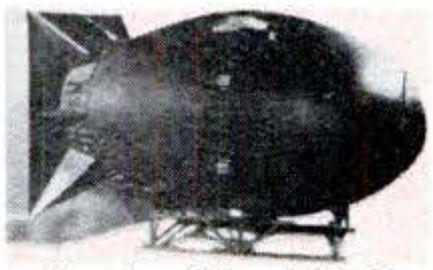

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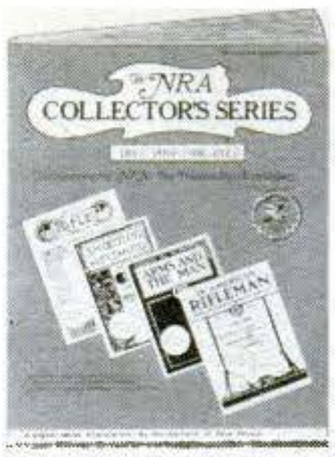

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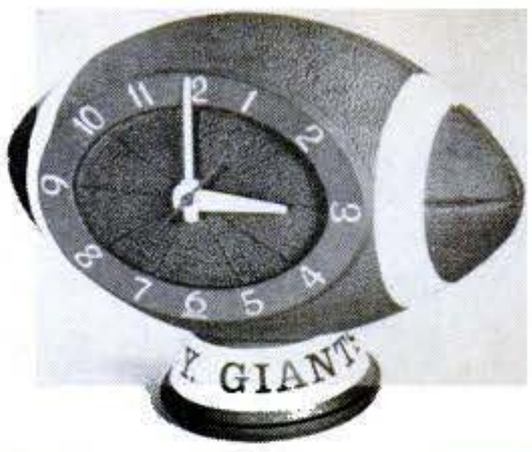

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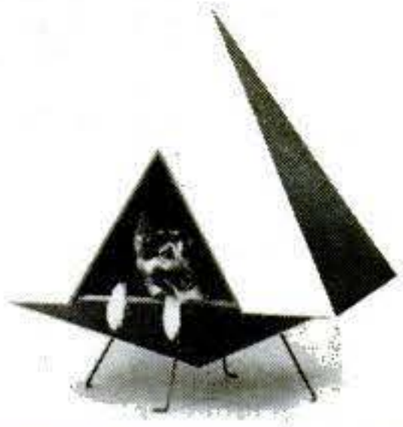

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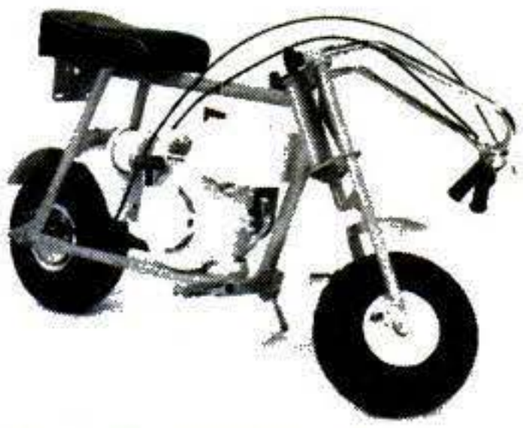

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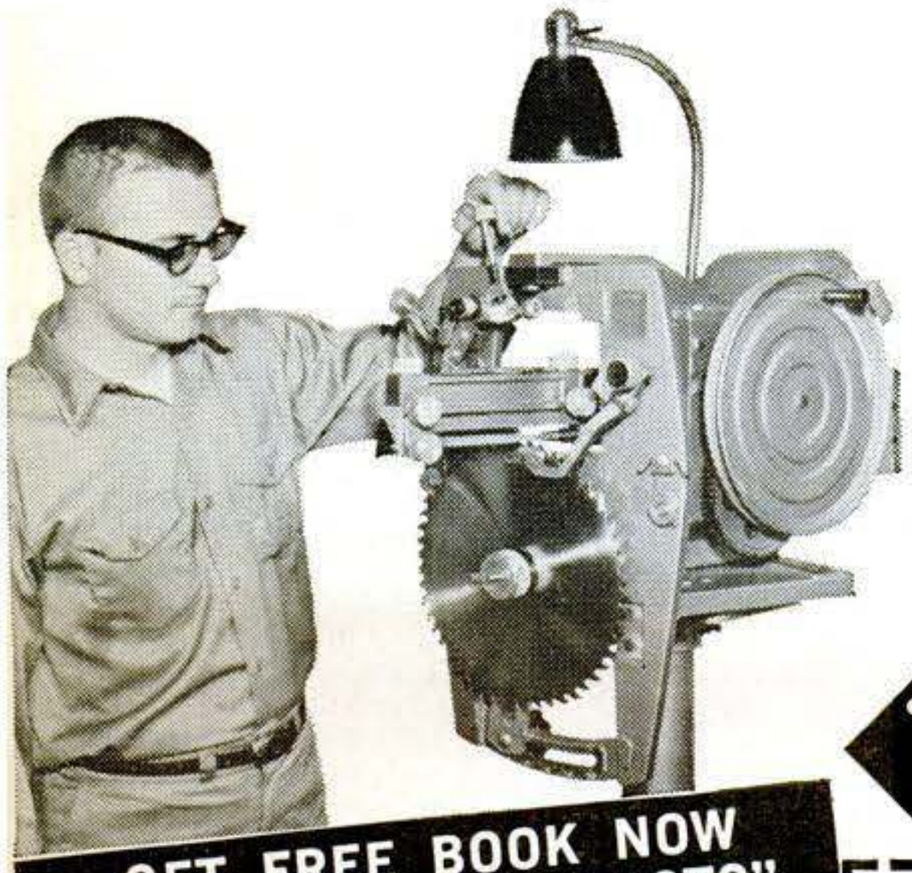

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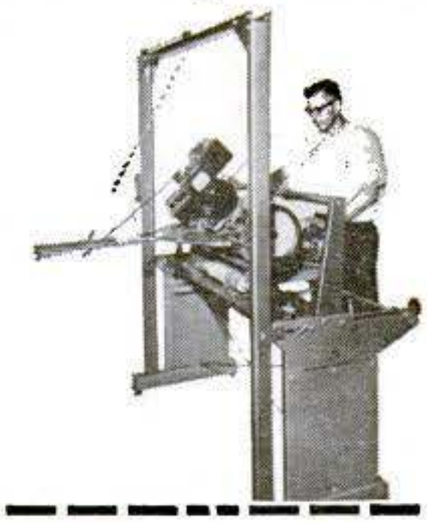

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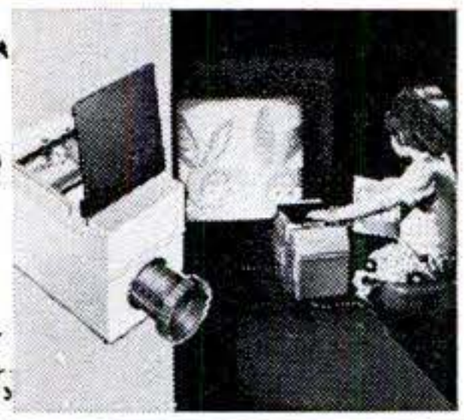

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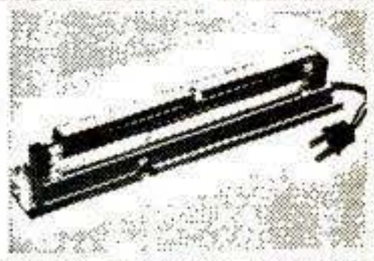

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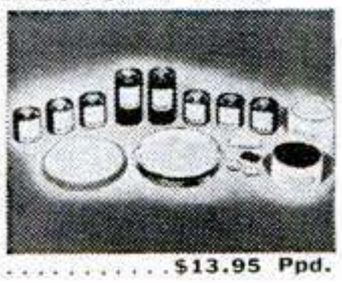

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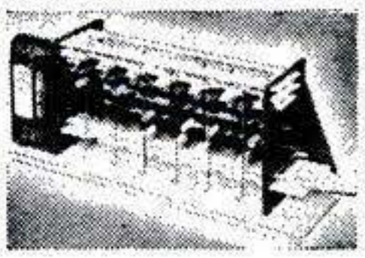

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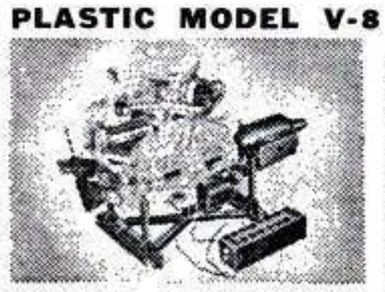

Hours of fun! Get thrill of building your own easily assembled engine from over 350 parts. Then push starter and watch it run. Crankshaft revolves, pistons move, valves open and close in sequence with spark plugs. Does everything but burn oil. ¼ scale, molded in 4 colors. Same motor used in many auto-mechanic courses. Excellent, easy-to-understand "Tech manual"

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1st *low-cost* survey-type instrument. Quickly provides quantitative results in threshold limit ranges set by Amer. Conf. of Gov't. Industrial Hygienists. Sensitive, accurate, wide measuring range. Includes 2 ampoules each to test for CO2, CO, H2S, NO2 and SO2. Sufficient for 2 to 4 tests depending on concentration. Lightweight Kit includes sturdy vacuum pump, coupling tubes, complete instructions with scales to determine results. Sets (4) of replacement ampoules available separately for $4.75.

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Giant 9 ft. model rises to amazing heights. Easy to assemble and launch. Use over and over. Low cost. Lots of fun. Can carry ½ lb. objects with string tether. Fly school colors at games, use for advertising, attach mirror—play "spy in the sky". Includes complete instructions, 16 pre-cut #1 white model paper gores, 8 red panels for portholes, wire, cord. Easily repaired if damaged.

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9 FT. HOT-AIR *BALLOON* KIT
Stock No. 60,691N ..... **$2.00 Ppd.**

INVISIBLE BLACK-LIGHT SPRAY

You can't see it under normal light, but under black-light, wow! It gives an eerie bluish-white glow to hundreds of things you'll think of for startling luminous effects. Create party costumes, decorations. Spray hidden messages around. Use on plastic, glass, wood, metal, styrofoam, papier maché, even fresh flowers! Washes off with any dry-cleaning fluid. Net contents: 13 oz. (enough to cover a 7 ft. Christmas tree with plenty left over).

Stock No. 71,276N ..... **$3.50 Ppd.**

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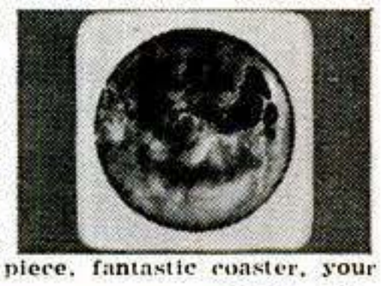

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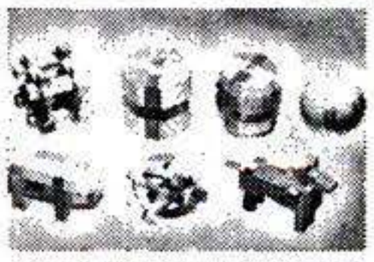

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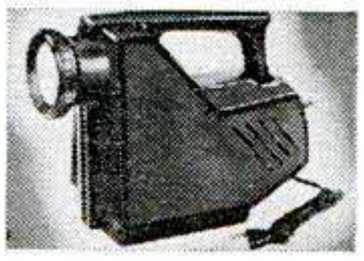

Projects illustrations up to 3" x 3½"—enlarges them to 35" x 30" if screen is 6½ ft. from projector, larger pictures if screen is farther away. No film or negatives needed. Primarily intended for children. Projects charts, diagrams, color or black-and-white in darkened room. 115 v A.C. . . . 6 ft. cord and plug included. Size 12" x 8" x 4½" wide. Weight 1 lb. 2 ozs. Plastic case.

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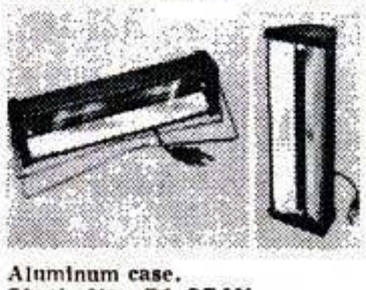
BLACK-LIGHT MIGHTY MITES



Relatively small (12") fixtures give surprisingly bright black-light. Mirror-finished reflector makes instant starting 8-watt, high-intensity bulb look like 40-watter. Up to 5,000 hours of safe, long-wave (3660A) black-light to really turn-on parties, light & theatrical shows, psychedelic decors, holiday decorations. Shockproof end-caps remove for safe, easy replacement of bulb and starter. Stands upright or horizontal. Aluminum case.

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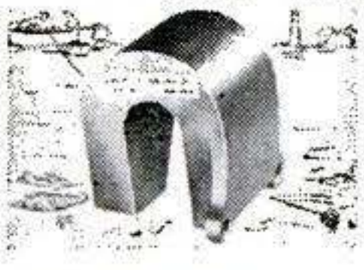

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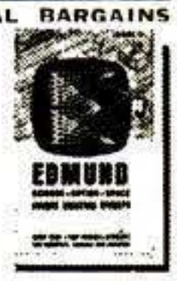

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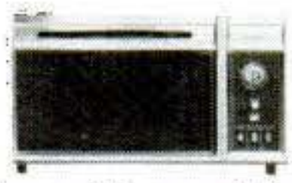

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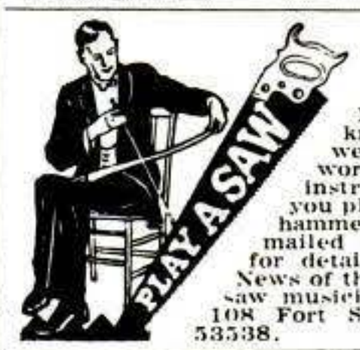

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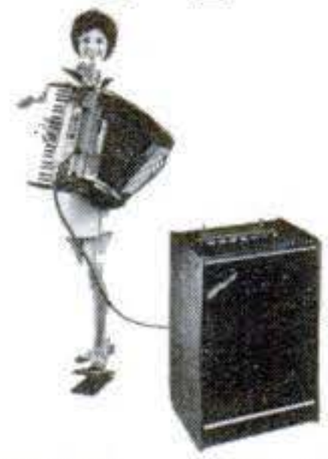

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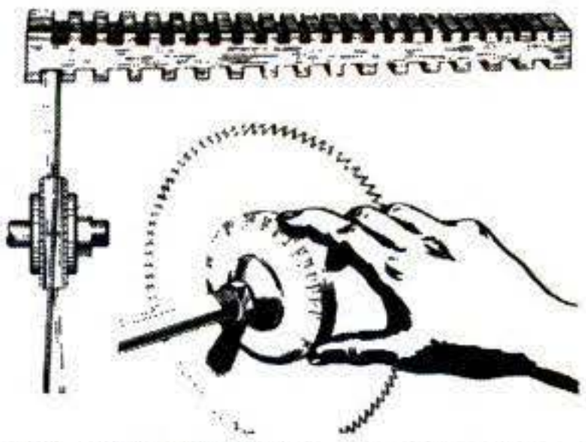

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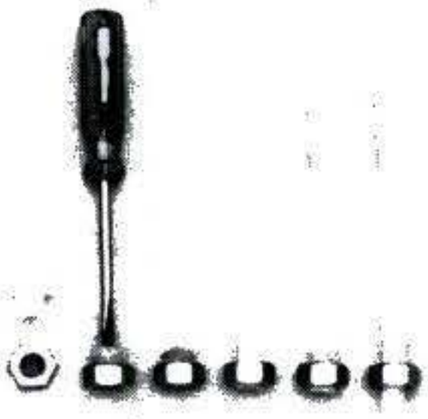

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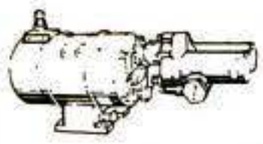

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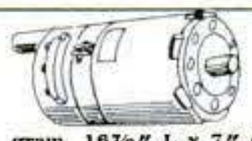

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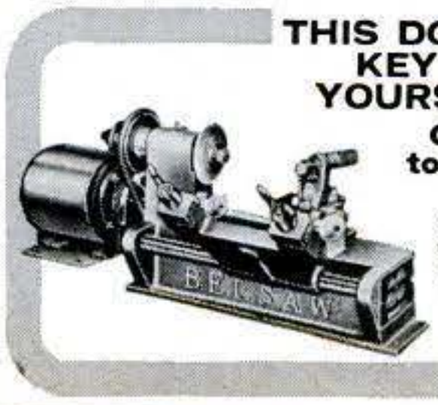

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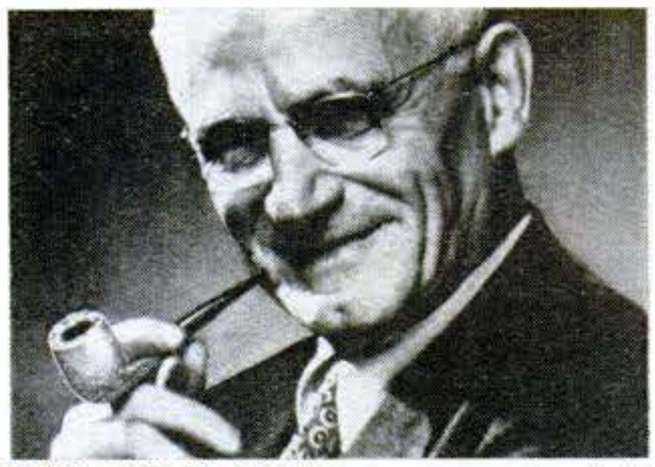
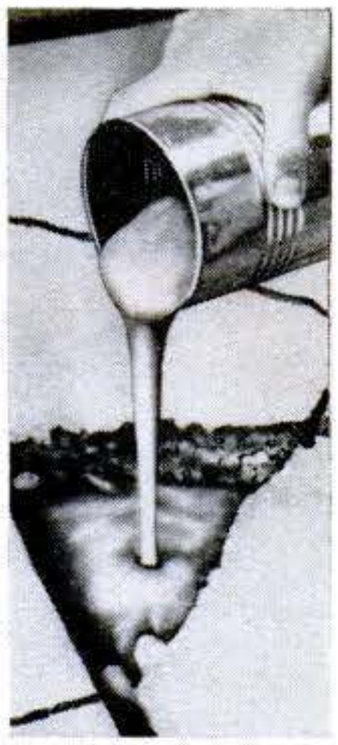
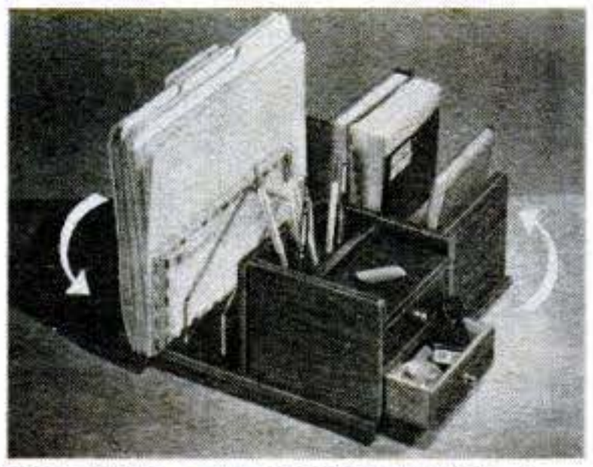


NEW CAREY PIPES are guaranteed to smoke cooler and milder. This new patented pipe construction will convince you of the pleasure of pipe smoking without bite or bitterness once you've tried it. Prove it to yourself. Smoke a new Carey pipe without risk. Send for facts on free 30-day trial offer. E. A. Carey, Dept PS3, 1920 Sunnyside, Chicage, Illinois 60640.



IN ONLY 15 MINUTES this new patching cement gets rock-hard, withstands over 9,200 lbs. of pull. Expands as it sets, locking itself permanently to everything it touches. Self-leveling. Set rails, posts, patch walks, basement floors, seal water leaks in basements & pools. #6668 QUIK-ROK, 1½ lb. box—$1.98 + 25¢ p.p. #6669 QUIK-ROK, 5½ lb. box—$4.98 + 55¢ p.p. Alexander Sales, Dept. PS-3, 26 S. 6th Ave., Mt. Vernon, N.Y. 10551.



REVOLVING DESK ORGANIZER keeps everything at finger-tip reach. Revolves on a ball-bearing base. Handsomely finished wooden desk organizer measures 11¾" x 11¾" x 5⅝". Larger compartment has two metal divider rods for file folders, stationery, etc. Two drawers with brass handles plus eight hole pen and pencil well. $9.98 ppd. Sunrise House, Dept. PS-371, Blake Bldg., Gilroy, California, 95020.

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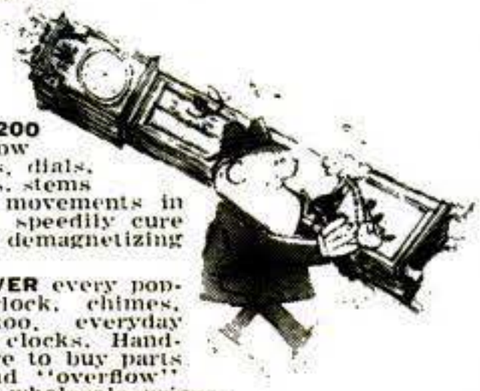

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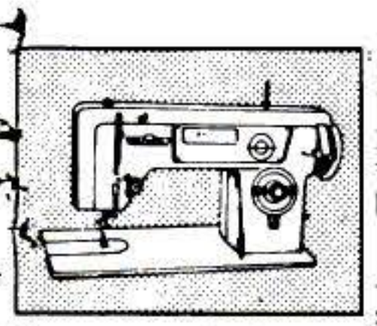

If you just bought this nationally advertised portable sewing machine for $99.95, **you overpaid by $64.95!**

Because you can actually buy the very same sewing machine direct from America's largest factory buying club—Unity Buying Service—**and you pay only the rock-bottom factory price of $35.00.**

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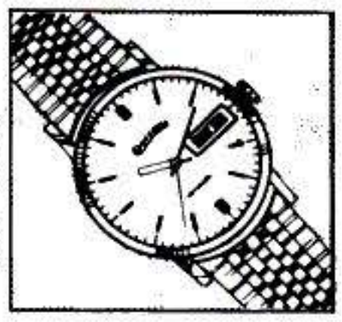
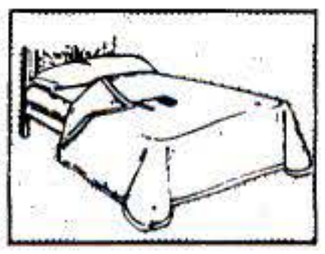


If you just bought this nationally advertised watch for $39.95, **you overpaid by $21.95!**



If you just bought this fully automatic electric blanket for $24.95, **you overpaid by $12.80!**

If you just bought this beautiful bone china dinnerware service for $171.95, **you overpaid by $91.95!**

If you just bought this top quality portable hairdryer for $22.95, **you overpaid by $12.46!**

If you just bought this nationally advertised tape recorder for $399.50, **you overpaid by $249.75!**

If you just bought this famous make spinning reel for $28.50, **you overpaid by $15.68!**

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The way Unity Buying Service works is really quite simple. As a new member, you receive our 420-page, full-color current catalog of first quality, name brand merchandise. More than 10,000 dependable, nationally advertised items, the kind featured by reputable department stores and merchants in your area, and in well-known national mail-order catalogs.

But there's one vital difference between Unity's catalog and others you may have seen. **The selling prices shown in our catalog are NOT your prices.** Your prices are the **factory prices** which average over 50% less than those shown in the catalog. These astoundingly low factory prices are all provided for you in the confidential Factory Price Book that all club members receive. This Price Book gives you your cost for each of the thousands of top-quality items in your Unity catalog. You pay only the price listed under "Your Cost" plus a modest 6% handling charge.

Guaranteed First Quality National Brands

Everything you order from Unity is brand new, nationally recognized, first quality merchandise in original factory cartons. Everything is guaranteed to please you . . . you must be completely satisfied, or simply return the item for exchange or full refund. All catalog items are stocked in our own modern warehouse where your orders are filled and shipped immediately. (Only exceptions are a few extra heavy or special order items.) You deal directly with Unity—and only Unity—at all times.

Earn Big Money In Your Spare Time!

Now, at last, you can buy dependable, nationally famous brands at factory prices, the way wholesalers and distributors do . . . the same wholesalers and distributors who supply all types of stores including discount houses. **Imagine the tremendous savings!** Savings so big, you can actually earn a substantial second income by acting as a local buying service, and selling to your friends and neighbors. Here's how easy it is: You offer your customers any merchandise in the Unity catalog at **dealer prices** or below. **And earn an average 25% profit for yourself.** For example, let's suppose a friend wants to buy a nationally advertised AM/FM solid state multiplex tuner with 8-track cartridge player and speaker system. The unit carries a suggested list price of $199.95. Regular dealer cost is $169.95—**but you pay only the factory price, $122.20.** Your friend pays the dealer price and saves $30.00, while you make a clear profit of $47.75 on this one sale alone!

Before long, the word will get around, and you could be handling orders for thousands of dollars worth of merchandise. Your substantial profits mount quickly into a sizable year-round income—**and all you invest is a few hours of your spare time!**

Whether you use your Unity membership for your own orders, for your customers' orders—or both—you can save many times the low membership fee of $6 with just your first purchase.

Even Greater Bargains!

As a Unity member, you always share in our tremendous buying power. For example, our closeout buyers continually comb the markets to bring you recently discontinued, top quality merchandise **at a mere fraction of the manufacturer's cost!** These incredible values are described and offered to you in periodic Closeout Bulletins—available only to Club members, of course.

But remember—whether you select from our Closeout Bulletins or our huge 420-page catalog, you are under no obligation to buy any minimum quantity. In fact, you are under no obligation to buy anything at all. You order as little or as much as you want, **when** you want it. No need to wait around for seasonal sales at your local stores. Unity's fantastically low factory prices are available to you at all times . . . yours to enjoy **365 days a year!**

Prove It Yourself! 30-Day No-Risk Trial!

Accept a trial membership **without risking a single penny.** Simply mail application. By return mail, we'll rush the Club's beautifully illustrated 420-page merchandise catalog and your confidential Factory Price Book. Examine everything thoroughly at your leisure. You must be convinced that these are by far the lowest prices you've ever seen anywhere for such top quality merchandise. Otherwise, merely return the membership material within 30 days for a full refund of your enrollment fee, promptly and without question.

Take advantage of this no-risk opportunity to get twice as much for almost every dollar you spend from now on! You simply can't lose. Mail the application **today** for sure!

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Yes, please enroll me as a member of your Factory Buying Club for one full year and rush my giant 420-page current catalog and confidential Factory Price Book for my personal use. I will also receive the 420-page 1971-72 catalog plus special closeout bulletins as they are issued. I understand there is no obligation to purchase anything. However, any merchandise I do decide to buy will always be shipped to me at rock-bottom factory prices. If not absolutely delighted, I may return the membership material within 30 days for prompt refund of membership fee.

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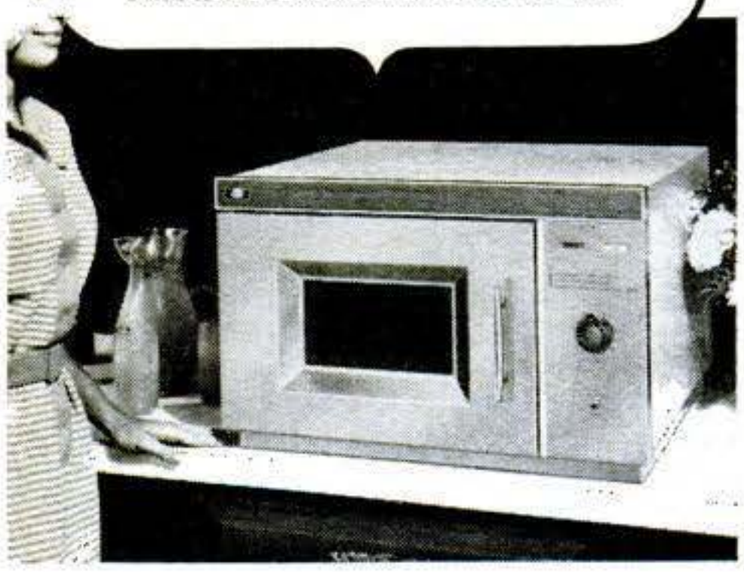

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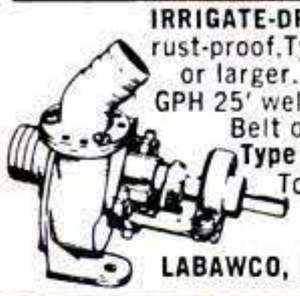

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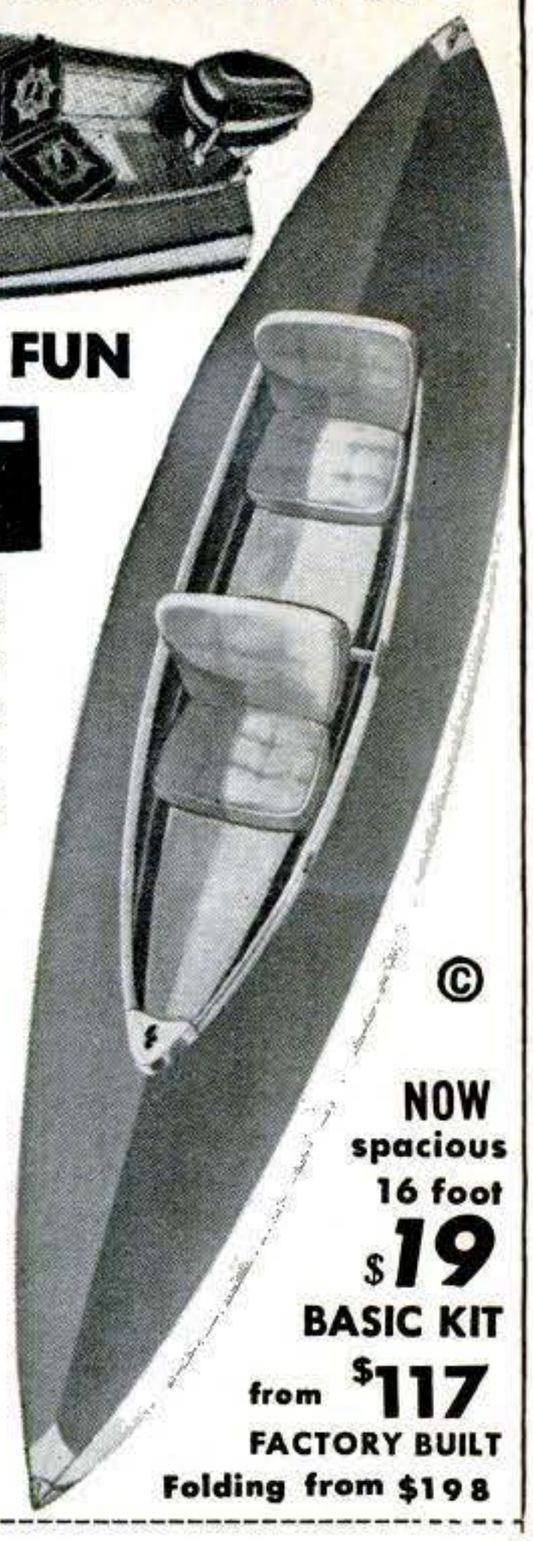

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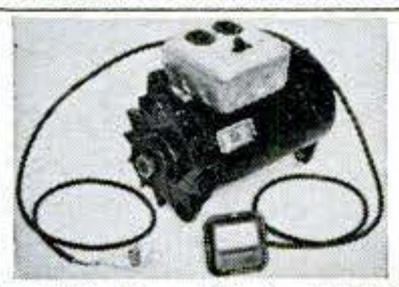

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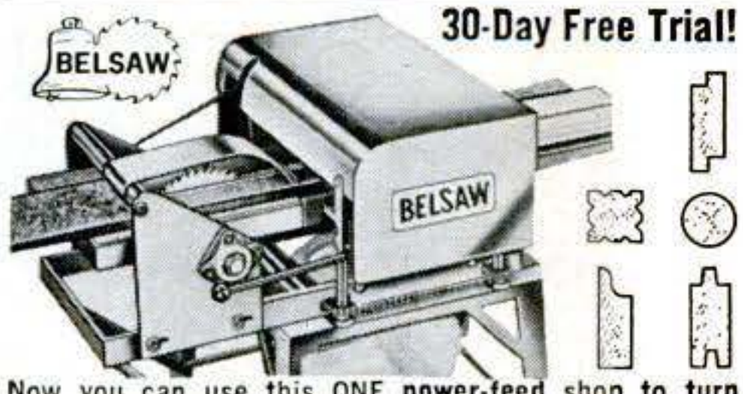

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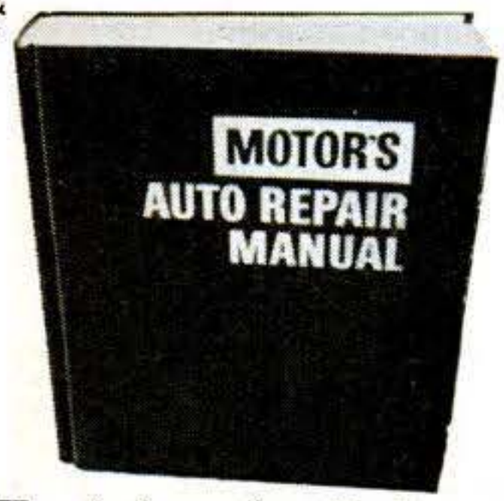

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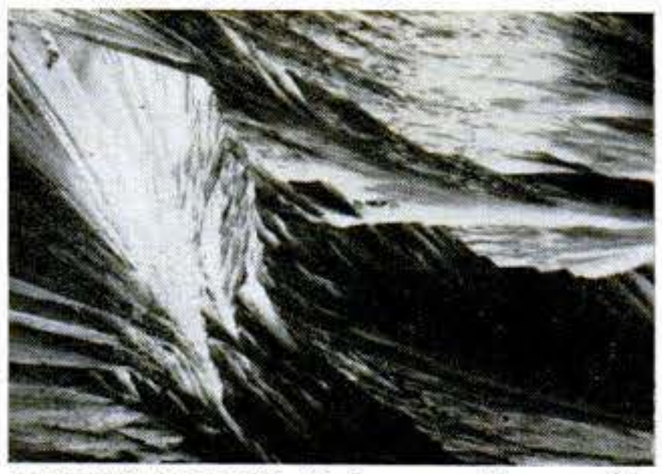

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by Jack Adams, Weekend Fisherman and Development Director, U. S. Biogenics, Inc.

I've just seen a fishing "miracle". With my own eyes I've watched the latest tests of a NEW FORMULA TO CATCH MORE FISH. I've seen fish pulled out of the water so fast it would make your eyes bulge and your heart pound with excitement. I'm convinced that this revolution in fishing can bring you MORE and BIGGER catches than any other method used before, as so many other qualified fishermen have already reported.

One of the amazing things about this method is that you don't have to change your rod, reel, line, bait, flies, lures, or anything else you now use. We don't care which Fishing methods, techniques and tackle you prefer. We'll even show you how to take fish out of waters where you never suspected fish existed! Make them hit your line again and again! in fact, we'll GUARANTEE IT MUST WORK *or it won't cost you one red cent!*

HOW CAN WE MAKE SUCH A GUARANTEE?

Here—at last—is the inside story of the results of an amazing group of experiments conducted by U. S. Government Scientists at the Bureau of Fisheries, and other scientists throughout the world.

These scientists were determined to find out exactly what it is that makes fish bite, and much to their astonishment they uncovered the very reason—the proof—of what had until then been only suspected—virtually all fish *finally select their food by smell—taste—touch!*

As a matter of fact, scientists have long known and wondered about the many kinds of fish that spend their entire lives down at the very bottom of murky deep waters, where no ray of light can penetrate. Yet these fish, living in total darkness, seem to have no more difficulty in locating food than those fish living in brilliantly lit waters nearer the surface.

These findings prompted our researchers to concentrate on the development of a super food/scent/contact-stimulant combining the most appealing smell/taste/touch-producing sensations found to attract fish.

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ORDERS MORE!

Enclosing photo of part of catch from recent sea fishing trip. Seldom have a chance to go fishing, so sure was glad to have Fish-X-236 along. Will order more shortly. *I. C. L., Fort Lauderdale, Fla.*

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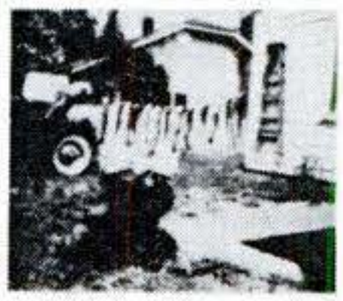
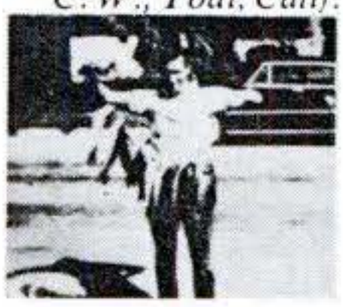
I've already tried it on bullheads, white perch. Not only caught the first fish, the most fish, but also the last fish! *S. K., Suncook, N.H.*

NICEST CATCH YET!

Sure was amazing the nice fish I caught. All I can say is it sure works on the big ones. I've done a lot of fishing in my days, but this sure was the nicest bunch of fish I caught yet, thanks to your Fish-X-236. *C. W., Yodi, Calif.*





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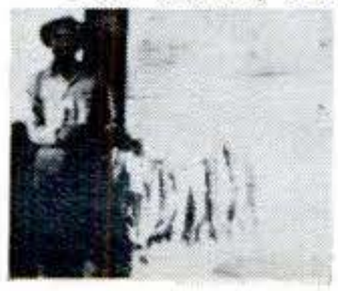

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Using Fish-X-236 took 16 Brownie and 2 other trout from a much overfished stream, plus a 24" trout over 3 lbs. from another stream. Reason to write was not only to praise your invention, but to see if I could handle it in my store. *C. R., Pennsylvania*

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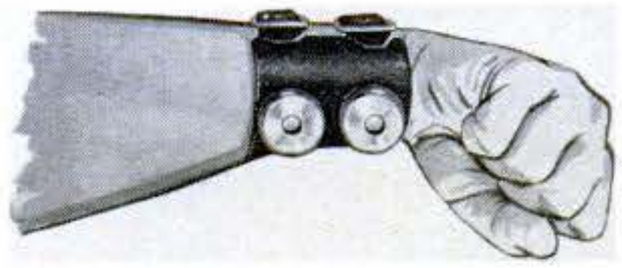

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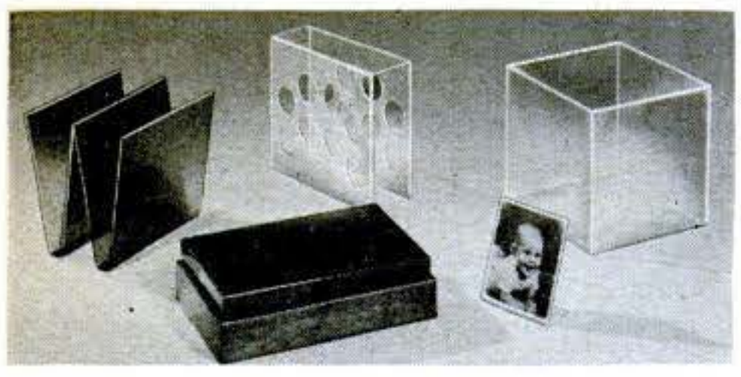

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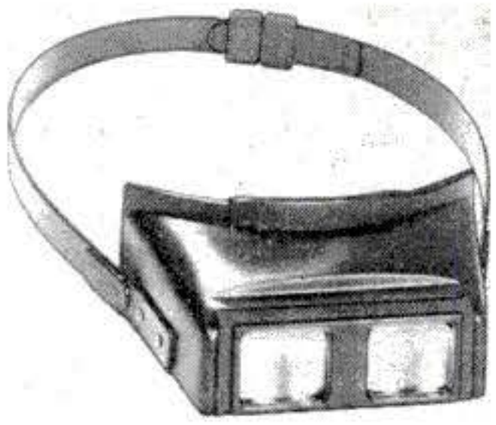

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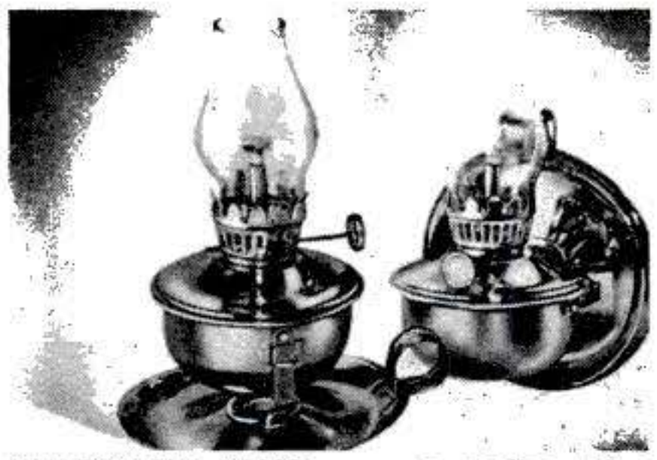

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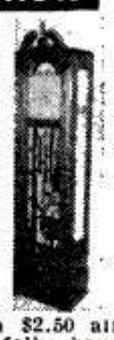

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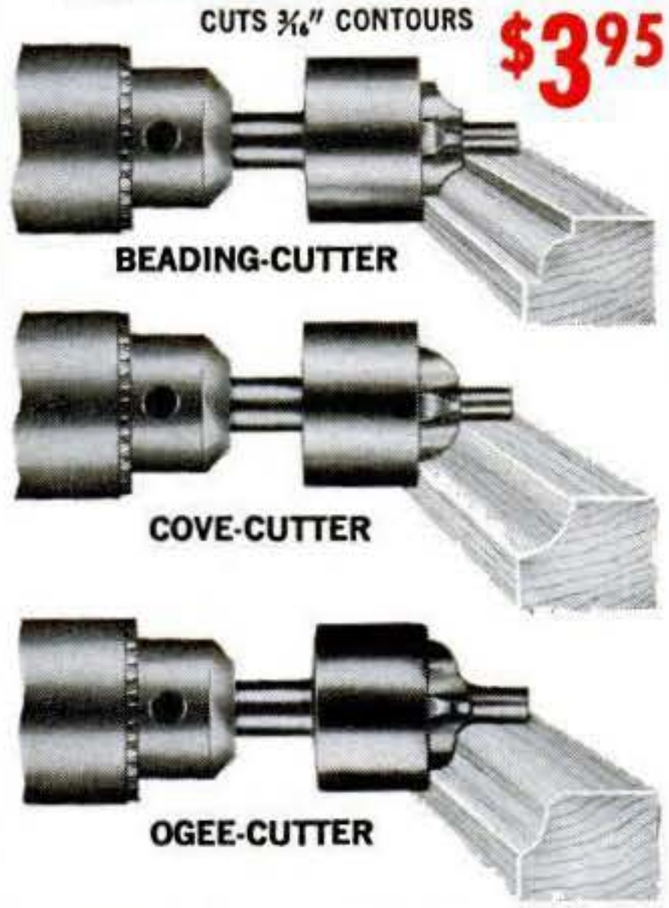

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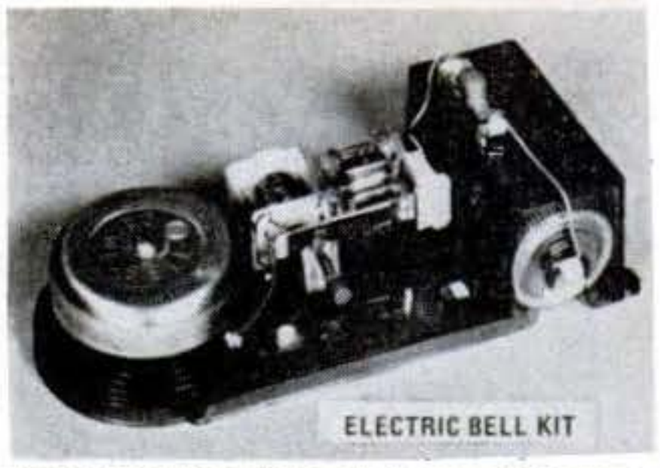

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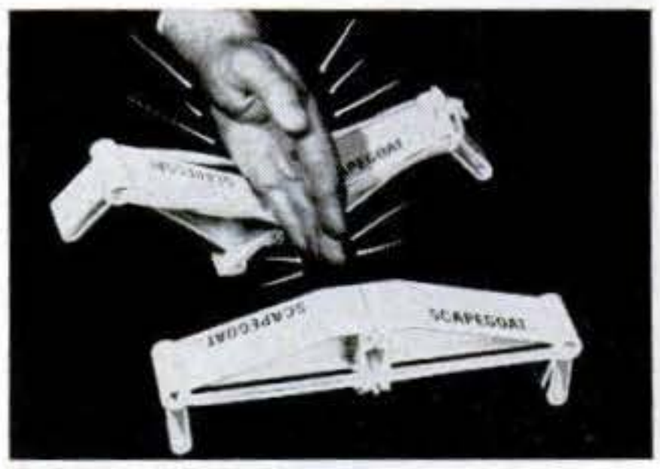

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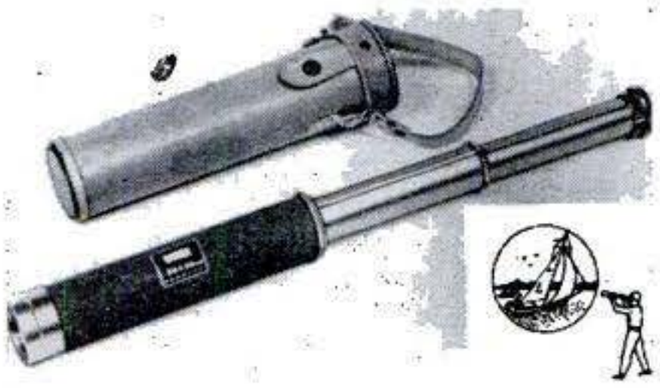

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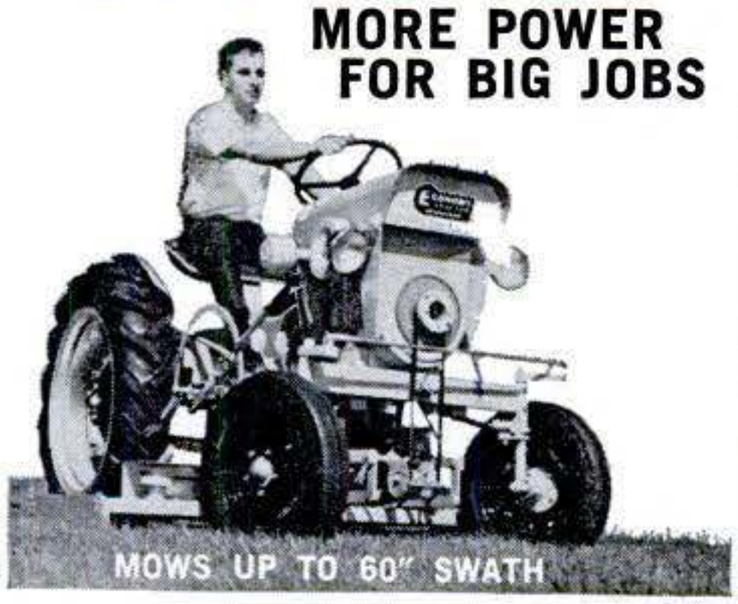

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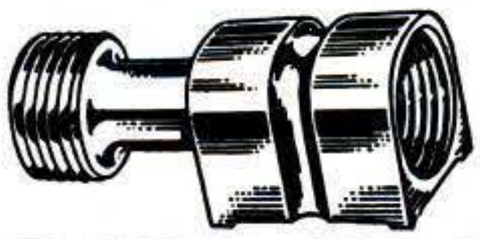

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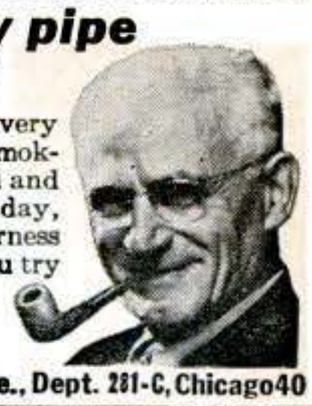

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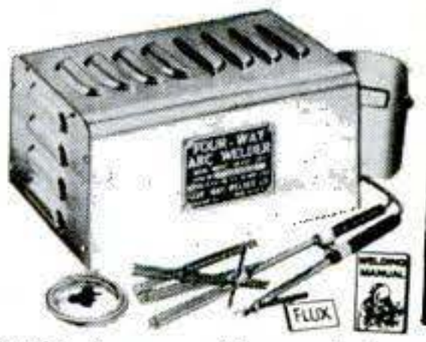

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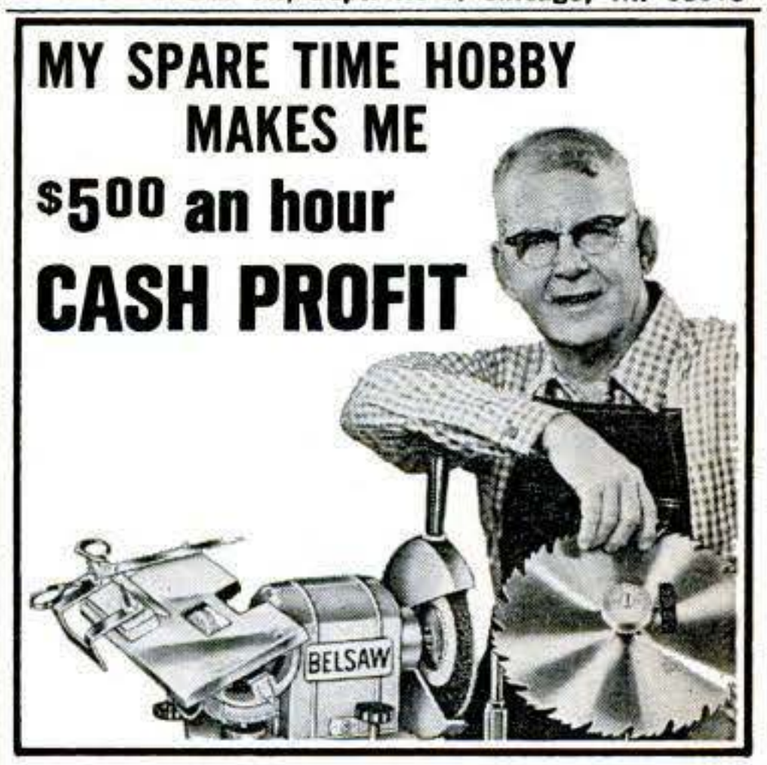

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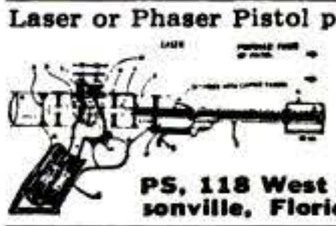

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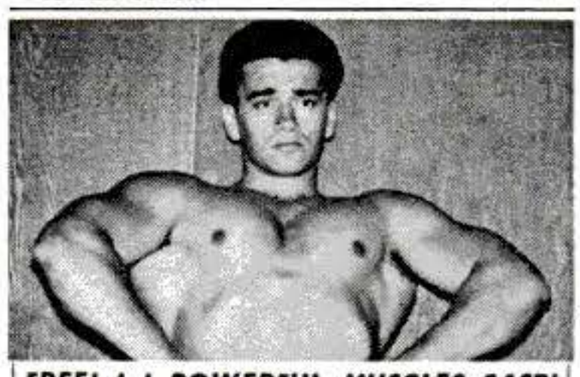

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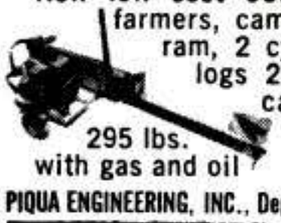

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